Georgia Monorail Consortium

Transit and Intercity Monorail Systems

Owen Transit Group, Inc.
Aebersold Technologies Corporation
AAR Corporation
Control Corporation of America
Transit Operating Services Company
MACTEC Engineering, Inc.
Tindall Corporation

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December 16, 2005

DEC 20 2005

Dan Leavitt, Deputy Director
California High-Speed Rail Authority
925 L Street, Suite 1425
Sacramento, California 95814

Subject: Bay Area Regional Rail Plan Comment:

Dear Mr. Dan Leavitt,

Please recall our brief but informative exchange at the "regional rail" public meeting on December 1 in San Francisco. Attached is a copy of our comments and proposed technology for the subject plan. For your convenience I have also included a complete copy of our MTC submission that contains more detailed information on the HighRoad system.

We appreciate your assistance in conveying this information to the appropriate members and staff of the California High-Speed Rail Authority for their consideration in the forthcoming planning period.

Please do not hesitate to contact me for any questions regarding the material presented, and I would be pleased to meet and discuss further any and all aspects of our proposal.

Thank you very much for your kind attention and best wishes in the upcoming efforts of the Authority for the successful planning and implementation of a HS system for California.

Sincerely,

David T. Gallo

David T. Gallo
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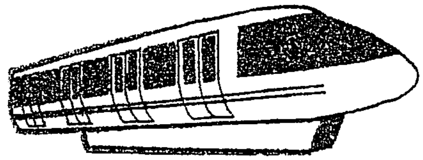

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December 14, 2005

Metropolitan Transportation Commission
101 Eighth Street
Oakland, CA 94607

Subject: Bay Area Regional Rail Plan Comment:

Dear Project Management Team Members,

On behalf of the Georgia Monorail Consortium, we are pleased at the opportunity to comment on the subject plan. We wish to comment on 4 specific planning areas and also provide information on our proposed alternative rail design for 21st Century transit.

Our central comment takes the form of a question: Why can we only think in terms of environment-unfriendly Railroad Trains, and cost-prohibitive BART Metro systems? What is so urgently needed at this stage of transport expansion in the Bay Region is a new lightweight rail design that is both affordable to build and operate, and more flexible for reaching into existing as well as new service areas.

While there is no one transportation mode that will solve all problems, the consideration of new rail system designs could be a relatively fast, easy and inexpensive way to provide effective service in the Bay Region. The fact remains that the cost of expanding current Metro rail systems is out of reach due to tight Federal and State spending, and burdensome local taxes. While conventional Railroad service on existing rail corridors could be more affordable than building new BART tracks, this transport mode is inefficient and environmentally unsound for the connector service desired to the Oakland International Airport, the downtown SF Transbay Terminal and the Larkspur Ferry Landing.

The attachments to our comments below contain specific information about the HighRoad Rapid Transit System (HRTS) that we are making available for appropriate consideration by the Regional Rail sponsoring authorities and study planning consultants (LTK Engineering). The key features of the proposed HRTS monobeam system are as follows:

- Not only does HRTS Monorail excel at people-moving performance, but at one-fourth of the cost of heavy rail and half the cost of light rail, it is among the most affordable systems today

- The dual-sided monorail (bi-directional), with single or double vehicles is an entirely different concept of operation from heavy rail and conventional railroad trains. HRTS runs smaller lightweight vehicles (120 passengers) and more frequent service (30 second headway) to accommodate people in time and space. This leads to smaller stations which means less cost and less space.

- Operating costs are estimated to be less than alternative systems due to lighter vehicle weight, lower energy use and automated controls. Lower operating costs, can more easily cover its costs from farebox revenues and not require additional operating subsidies. Lower operating costs may also allow recovery of the cost of construction. This efficiency can eliminate the need for added taxes for system construction and operation subsidy

- Elevated operation is less obtrusive than other forms of rail including earlier monorail designs. (6.5 feet for monobeam vs. 15 feet for monorail vs. 25 feet for conventional and heavy rail.

- The urban and the intercity systems use compatible guideways permitting urban system travel up to 70 mph, and longer distance HS service (Silver Bullet) of more than 200 mph.

- Modular construction and less disruption during construction periods are important benefits of this design. The first beam of the Las Vegas monorail system took less than three hours to install since it was fabricated off site. And, that beam was installed in about five months following ground-breaking. We estimate the rate of guideway construction at about 20 miles per year, assuming 3 shift crews working year round

- Lower construction costs, are demonstrated below in the estimated costs for some proposed extension lines in the Regional Rail plan, and for a 100 percent replacement of classic BART.

Comments Section

1. Improved Connections Between Passenger Trains and Other Transit Connections:

We urge MTC to consider alternative means for connecting service between the Caltrain terminus in SF and the downtown Transbay Terminal. We believe the proposed construction of a railroad tunnel to accommodate extension of Caltrain's direct service into the downtown area is expensive, extravagant, and environmental undesirable. The modern trend worldwide is to move the 19th century railroad train whenever and where ever possible, away from urban centers. Even if tunneling funds materialized as part of an overall California High Speed Rail network initiative, which is still uncertain at this time, newer transit rail designs can provide "lighter" alternatives for this connection at only a fraction of the cost of railroad tunneling. With SF Muni buses providing the current connector service into the SF downtown area, then it seems appropriate to offer the remaining Cal Train passengers a connection to the Transbay Terminal by elevated and automated guideway service. An elevated system is particular important to avoid accidents and adding more street congestion in the downtown area. Furthermore, the easier-to-build alternatives shorten and simplify the construction activity that is economically disruptive to local businesses.

The current Oakland Airport Connector project is a perfect example of where alternatives are being used. In this case BART is seeking an alternative means to its own "Metro System" technology for making a more cost effective connection to the International Airport

Similar consideration can be made for a connection between the San Rafael train station and the Larkspur Ferry. We agree that the proposed SMART rail system in Sonoma and Marin must have an easy and quick connection with the ferry service in Larkspur to be successful.

2. Expand the Regional Rapid Transit Network

We urge MTC to consider less costly alternative rail designs for expanding the existing Rapid Transit Network in the Bay Area to any of the proposed areas shown on the planning map. A major constraint to expansion has and will continue to be, the high cost per mile of extending the current system, especially in view of tighter Federal/State spending (growing Federal/State budget deficits), and more cautious spending by a local population already burdened by heavy sales and other taxes and bond indebtedness. We believe that the Bay Region planning must take into account that we are entering a new era of scarce funding resources for transport expansion projects.

Alternative design systems must also be highly oriented to individual service to attract people away from their privately owned vehicles. The Railroad passenger service offers some bay area commuters an alternative to their autos, but the speed and frequency of this service has not appreciably improved in 100 years.

We do, in fact, need to build E-BART between Bay Point and Brentwood but not with BART passenger trains that are too expensive to build and operate and which cannot improve the speed and timeliness of individual service.

We do, in fact, need to extend BART roughly 16.3 miles from Fremont to San Jose, but not with an estimated $ 4.7 billion BART system.. Furthermore, expanding the ACE system may be faster than building a new BART line, but certainly not much faster than the time needed to construct the guideway for a new lightweight and streamlined system design making use of modular and prefab construction methods. Also, the use of new elevated designs can bring the transit system into the downtown area of San Jose without the need for expensive underground tunneling.

3. Consider Various Rail Technologies Including New Designs of Existing Technologies

We support consideration of various rail technologies and urge MTC and the CHSRA to also include in the planning studies, an exploration of "new" rail designs of existing technologies. Rail transport technologies have progressed from the 19th century railroad design, to the 20th century "Metro" train design. Two other rail designs were introduced in the early and mid 20th century for local area transport, namely, the light rail system, and the elevated monobeam systems (monorails). Both provide low-impact (environment) and effective service but only as low-speed and low-passenger volume carriers and are not suited for rapid transit serving densely populated areas.

Specifically, newer lightweight rail designs (21st Century) with a smaller infrastructure, can boost the speed and carrying capacity of 1st Generation monorail designs. Furthermore, the streamlined design can provide a lower build/operate cost structure, further reduce noise and other environmental impacts, and improve service frequency by offering passengers a ride that meets their personal schedules (more frequent service). The new designs can be constructed with existing and proven off-the-shelf components already in operation. (See attachment 7)

We believe the 2nd Generation monorail would also supply proposed High Speed service connecting the Bay Region to the Central Valley. The newer designs can provide speeds up to 214 miles per hour. In the prior century, the introduction of high-speed railroad train technology for rapid long distance service in Japan, Europe and elsewhere, has proven effective but also expensive to build and operate and are not without significant environmental concerns. Thus, both HS railroad technology and Metro train systems both have environmental and fiscal constraints. Nonetheless, we believe high-speed rail service using more current technology can still be considered highly desirable as an alternative to growing traffic congestion along California's interstate highways and inside our airports. In the interests of providing lower cost, environment-friendly service, we hope the MTC and CHSRA will consider alternatives to Railroad and Metro technologies.

In summary, we believe it is important that consideration be given to newer streamlined, rail designs that are cost effective, and environmentally sound and that can address rapid mass transit needs on a regional, inter-city, and statewide basis.

4. Rail Investment for Transit-friendly Communities, Business, and Urban Redevelopment.

We believe that rail transit investments can achieve these goals if the rail systems can be tailored to fit, a low-impact system with a friendly appearance that neither intrudes nor distracts from commercial and leisure activities. Achieving "low impact" means the transit system, consisting of guideway, vehicles, and stations, must be as small as possible without sacrificing the need for timely service and passenger volume. In the past this has meant placing rail system cars or trains, and stations completely underground and out of view when possible, or in the case of at-grade systems, further away from the areas of activity. Consideration needs to be given to less-intrusive low-impact systems so that rail transit can bring humans directly and timely into the activity area without disrupting the area. Rail systems that have a smaller footprint, i.e. small stations, individual cars rather than trains, quiet operation etc. can enter shopping centers, sports complexes, downtown areas, and other transit converging stations all with minimal disruption to area activities.. This feature allows rail transit to serve people which is the basis for economic development or renewal in the transit areas or destinations..

One example could be the proposed expansion to San Jose, where the new low-impact elevated design can bring service into the downtown area with minimal disruption to economic activities during the construction period and virtually no disruption during subsequent operation of the system. Other examples are connection links from CalTrain to Transbay Terminals into downtown SF or from downtown San Rafael to the Larkspur Ferry landing.

Alternative Design of Existing Technology

We present the attached material about the HighRoad Rapid Transit System (HRTS) to MTC and CHSRA for the planning study. A comprehensive overview of all HRTS design components can be found in the HighRoad Technical and Management Briefing Book (see attachment 6). We trust this information will be considered in the "screening phase of the Rail Plan Step-by-Step process. Please do not hesitate to contact us for further information or discussions at any time.

To further demonstrate the potential of HRTS to provide cost effective service to the Bay Region, we offer below the preliminary cost estimates (for planning purposes only) for various proposed projects. To further illustrate the streamlined design of HRTS, we estimate the rate of guideway construction at about 20 miles per year, assuming 3 shift crews working year round.

Finally, we included a cost estimate for BART replacement using HRTS because of the previous suggestions from other transit consultants that BART compare the cost of 100 percent replacement with a new system vs. the cost of a very long-term step-by-step renovation of its current 35 year old system. The importance of such a comparison is particularly acute when considering the words from the Draft Short-Range Transit Plan &Capital Improvement Program: FY06 through FY15:

"Although the completion of the first generation renovation program ($1.5 Billion) represents a significant achievement for which BART and its funding partners can be justifiably proud, there remains the formidable challenge of funding and implementing a second or next generation renovation program, which, by necessity, will go much deeper into the physical plant of the system."

<u>Estimated Cost of Proposed Expansion Projects Using the HighRoad Rapid Transit System.</u>

Oakland Airport Connector Line (3.2 miles with travel times less than 3 minutes): $ 214 million

E-BART Transit Line (23 miles, 6 stations):

- Regular Transit Service (70 mph service): $ 950 million.
- High Speed (Silver Bullet Version with 214 mph service): $ 1.02 Billion.

Note: Both Regular and High Speed Service use the same guideway and station infrastructure

Fremont to San Jose: (16.3 miles, 4 stations) : $ 700 million

BART "Next Generation" Replacement: (104 miles, 43 stations): $ 4.2 billion

Sincerely,

David T. Gallo
Director of Marketing
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dgallo1@mindspring.com

GEORGIA MONORAIL CONSORTIUM
STATE OF GEORGIA
AUTHORIZED SIGNATURE

Attachments: HighRoad Rapid Transit System:

1. HighRoad Rapid Transit System: General Description and System Specifications
2. Owen Transit Group, Inc. (HighRoad Design Company)
3. HighRoad and Heavy Rail
4. HighRoad and Light Rail
5. Silver Bullet and Commuter Rail
6. HighRoad Technical and Management Briefing Book
7. Confidence in HighRoad Design
8. Selected HighRoad Design Illustrations

CC: California High Speed Rail Authority

OTG HIGHROAD RAPID TRANSIT SYSTEM

General: Light rail transit systems have been in use world-wide for over 110 years, offering low-speed light capacity transit for use principally in high density urban settings. The HighRoad RTS (Rapid Transit System), a dual-sided monorail, is a newer type of transit which provide vehicles running on opposite sides of a single elevated guideway. Since right-of-way usage is minimized, system flexibility is maximized and disturbance to the community during construction is minimized. These pages are to define some of the HighRoad RTS distinctive features.

Performance and Speed: The HighRoad RTS offers 70 mph service (120 kph), and uses one or two vehicles of 120 passengers each arriving/departing at short intervals. As brief as 15 second headway intervals can be achieved by using a patented extended dwell time procedure, resulting in as many as 57,600 passengers per hour per side with a two-vehicle consist. The HighRoad RTS can approach the capacity of heavy rail in extremely dense urban settings. The HighRoad RTS is capable of up to 7 % grades, made possible by its high horsepower motors and the multiple braking systems provided.

Capital Cost: Published cost of the HighRoad RTS for construction in the United States is in the range of $35 to $39 million per mile ($22-24 million per kilometer) , depending on number of vehicles, stations, and topography. Estimated costs include right-of way and utility relocation allowances, design fees and licenses.

Operating Costs: The HighRoad RTS operating costs are estimated to be less than alternative systems due to lighter vehicle weight, lower energy use and automated controls. As a result of the lower operating costs, the HighRoad RTS can more easily cover its costs from farebox revenues and not require additional operating subsidies. Lower operating costs may also allow recovery of the cost of construction. This efficiency can eliminate the need for added taxes for system construction and operation subsidy.

Vehicles: The HighRoad RTS vehicles are designed with advanced lightweight composites and use existing, proven components for its construction. These include proven-in-service doors, air conditioning, VFD motors, solid-state power controllers, signal controls, security systems, and pneumatic braking components. The HighRoad RTS has very large panoramic windows on both sides of the vehicle, making the passenger trip more enjoyable. In emergency evacuation procedures the HighRoad RTS windows on the guideway side are hinged for passengers or rescue personnel to access the top of the guideway in the event an evacuation is needed. This window arrangement also allows another vehicle to attend a stopped vehicle on the guideway and transfer personnel from one vehicle to another. Computer wireless internet connection is available for passengers.

Propulsion: The HighRoad RTS system uses standard AC electric VFD (variable frequency drive) motors with digital solid-state controls to provide smooth accelerations, including short-term motor overloading, allowing increased horsepower for acceleration and climbing of grades. Motive power is applied to a motor drive wheel located in the area under the guideway upper overhang which affords all-weather protection.

Braking: Each HighRoad RTS vehicle uses regenerative AC motors and solid-state controls to provide 100% braking during normal operation. In addition, the HighRoad RTS vehicle has two 100% stand-by pneumatic fail-safe auxiliary braking systems which apply braking to a fixed braking rail on the guideway, avoiding potential loss of brakes by “heat fade”. All three systems are used to provide for emergency braking. The added braking capability of the HighRoad RTS system allows safe descent of steeper gradients. The pneumatic brake systems on the HighRoad RTS are redundant and fail-safe, so that in the event of power failure or loss of pneumatic pressure the vehicle will quickly brake to a full stop. Brakes are not dependent on the condition of a brake drum, disc, or inflation of a tire. In icing areas the drive and braking rails can be head-traced to provide for 24-hour de-icing and snow removal.

Tracks and Guideway: HighRoad RTS wheels are steel which run on steel rails. These rails are attached to a high-mass concrete beam and uses sound-deadening material for the "Quiet Rail" patented rail surface support by the concrete. The HighRoad system of three-wheel connection provides a non-derailable attachment to the guideway and eliminates flange grinding with its no-flange wheels. Additionally, the drive wheels and the top rail of the HighRoad RTS guideway are protected from snow and ice accumulations by the overhanging top of the guideway. Steel wheels eliminate loss of reliability due to blowouts and routine deflation of tires. Also, steel wheels obviate the need for routine replacement of tires on the system. And steel wheels allow for a no-bounce wheel, improving passenger comfort.

Stations: The standard size for a HighRoad RTS station is 45 feet long (15 meters), with a typical 132 foot station width (40 meters), determined by the standards of the National Fire Protection Association (NFPA/ANSI-130 and NFPA-101), security and personal safety requirements, and compliance with the Federal Law governing accommodations for persons with disabilities (ADA). HighRoad RTS stations are accessible from each side of the station and accordingly have two sets of stairways and elevators, with crossover stairs and elevators to the crossover level. Stations can be added to a guideway without interruption of service.

Power and Controls: The HighRoad RTS uses a widely available voltage (480/277 Volt 3-phase AC) for supplying power by means of dual pantographs running on power bars located beneath the guideway top overhang. The HighRoad RTS station embodies an auxiliary power generator to maintain the station in full operation (elevator, lights, security, guideway doors) and provide partial power to the guideway power bars for safety power to the vehicles. On-board UPS (uninterrupted power source) batteries are provided in the HighRoad vehicles for continued safe operation of controls even during a power shut-down.

Safety: The shape of the HighRoad RTS guideway provides a wide, flat surface on the top for an emergency walkway accessible from a stopped vehicle in accordance with NFPA/ANSI-130. Additionally, this same guideway top surface allows a rail-guided emergency vehicle (such as an Emergency Medical Service or Fire Department vehicle) to quickly reach passengers in the vehicle. This vehicle can also be used to push a disabled vehicle to a nearby station or service area.

Materials used comply with the Federal Transit Administration standards for fire and smoke safety criteria. An emergency telephone is provided for passenger use. Emergency voice speakers for safety instructions are provided. The HighRoad RTS vehicle also has real-time television cameras and sound monitoring in the cabin for continuous remote observation by security officers.

Conclusion: The HighRoad RTS offers clearly distinctive advantages over other alternatives for public transportation, and can provide a high quality, high capacity solution to transit requirements.

The above information was obtained from the Owen Transit Group, Inc. web site and technical manual.

Prepared by: Owen Transit Group, Inc.
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HIGHROAD SYSTEM SPECIFICATIONS	
SYSTEM:	
SPEED	70 MPH
NORMAL CAPACITY	28,800 PPHPD
MAXIMUM CAPACITY	57,600 PPHPD
VEHICLE:	
LENGTH	45 FEET
WIDTH	9 FEET
HEIGHT	11 FEET
CAPACITY	120 PASSENGERS
SEATS	33
STANDING	87
WHEELCHAIRS	4
MATERIAL	COMPOSITES
DOORS	4
AIR CONDITIONED	YES
ATTENDANT	NONE
TOILET & GALLEY	NONE
CHASSIS:	
MATERIAL	STEEL
WHEELS	STEEL
BRAKES	9.6 F/S/SEC
(BRAKES)	3 M/S/SEC
POWER:	
VOLTS	480
PHASE	3
TAKEOFF	PANTOGRAPH
MOTORS:	
MANUFACTURER	SIEMENS
NUMBER	2
HP / OVERLOAD	250 / 450
TYPE	TEFC/VFD
RPM	1750
DRIVE	DIRECT
CONTROL	VFD
BRAKING	REGENERATION
CONTROLS:	
MANUFACTURER	SIEMENS
TYPE	DIGITAL
GUIDEWAY:	
MATERIAL	CONCRETE
RAILS	STEEL PLATE
ELEVATION	18 FEET
TYPE CONSTRUCTION	PS / PT SEGMENTED
COLUMN SPACING MAX	200 FEET
ROUTE SWITCH TYPE	SWING BEAM
REVERSING SWITCH TYPE	ROTARY
CODES:	
TRANSIT CODE	NFPA / ANSI - 130
ELECTRICAL CODE	NFPA / ANSI - 70
CONCRETE CODE	PCI

SILVER BULLET SYSTEM SPECIFICATIONS	
SYSTEM:	
SPEED	200 MPH
NORMAL CAPACITY	28,800 PPHPD
MAXIMUM CAPACITY	57,600 PPHPD
VEHICLE:	
LENGTH	45 FEET
WIDTH	9 FEET
HEIGHT	11 FEET
CAPACITY	43 PASSENGERS
SEATS	42
STANDING	0
WHEELCHAIRS	1
MATERIAL	COMPOSITES
DOORS	2
AIR CONDITIONED	YES
ATTENDANT	YES
TOILET & GALLEY	YES
CHASSIS:	
MATERIAL	STEEL
WHEELS	STEEL
BRAKES	9.6 F/S/SEC
(BRAKES)	3 M/S/SEC
POWER:	
VOLTS	480
PHASE	3
TAKEOFF	PANTOGRAPH
MOTORS:	
MANUFACTURER	SIEMENS
NUMBER	4
HP / OVERLOAD	250 / 287
TYPE	TEFC/VFD
RPM	3400
DRIVE	DIRECT
CONTROL	VFD
BRAKING	REGENERATION
CONTROLS:	
MANUFACTURER	SIEMENS
TYPE	DIGITAL
GUIDEWAY:	
MATERIAL	CONCRETE
RAILS	STEEL PLATE
ELEVATION	18 FEET
TYPE CONSTRUCTION	PS / PT SEGMENTED
COLUMN SPACING MAX	200 FEET
ROUTE SWITCH TYPE	SWING BEAM
REVERSING SWITCH TYPE	ROTARY
CODES:	
TRANSIT CODE	NFPA / ANSI - 130
ELECTRICAL CODE	NFPA / ANSI - 70
CONCRETE CODE	PCI

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High Road – Monorail Rapid Transit System – (Second Generation)

Introduction:

Owen Transit Group, Inc. is a mechanical engineering firm based in Marietta, Georgia, which has privately funded the development of the HighRoad Monorail Rapid Transit Monorail System design concept to its current state. With expertise in mechanical, electrical, environmental, and liquid/gas systems, the engineering staff has applied over one hundred years of experience to establishing this new kind of monorail.

William E. Owen, P.E. – founder & President of OTG, Inc.

William E. Owen, originally a native of Birmingham, Alabama, obtained an extensive and varied background in engineering. Mr. Owen graduated from Auburn University in 1955 with a degree in Mechanical Engineering. He subsequently attended George Washington University in Washington, DC, where he earned his Master of Engineering Administration degree in 1959. He became certified as a Registered Professional Engineer in 1974 following examination by the Georgia Professional Registration Board and presently is registered in eight states. He was appointed to a seat on the Cobb Community Transit Advisory Board by the Cobb County Board of Commissioners in 1990. Mr. Owen has been certified as a Mass and Rapid Transportation Planning consultant by the Georgia Department of Transportation.

Work Experience

Upon completion of his undergraduate degree course work, Mr. Owen was employed as an aerospace power plant design engineer at General Dynamics in Fort Worth, Texas. There he was assigned to the design team for the then-classified Mach-Two B-58 bomber. After his military service in 1959, he was employed by the Lockheed Aircraft Corporation in Marietta, Georgia, as Assistant Federal Aviation Agency Coordinator, gaining FAA approval of the designs for the JetStar and C-141. He later worked as a project coordinator in Lockheed's engineering program planning and scheduling department (costs and budgets). In 1967 he joined the sales group for the commercial version of the C-5A cargo airplane, the L500. At present, he is the President of Owen Transit Group, Inc, and its mechanical engineering division William E. Owen & Associates, of Marietta. The firm provides consulting engineering services primarily throughout the Southeastern United States.

Monorail Innovation: High Road System

The United States Patent Office granted him a patent for the "Side-mounted Monorail Transportation System" in 1987. Being marketed as the HighRoad Monorail Rapid Transit System, the system patent embodies 17 separate patent features. An additional patent embodying

22 additionally unique features is in process. The system design accommodates urban/suburban transport as well as the transport of freight, and high-speed intercity commuting. Mr. Owen says the system's benefits result from a simplicity of design. The system design is among the most cost-effective systems currently available. Mr. Owen states:

"Its low construction and operation costs coupled with its massive transporting capacity, make it a powerful component in the solution to our regional and large city commuting problems."

Owen Transit Group, Inc. is licensed by Mr. Owen for the marketing of the technology.

HighRoad Monorail Urban/Suburban Vehicle Model

The HighRoad Monorail System's urban / suburban vehicle model employs the use of existing components and is designed to combat the specific weaknesses of other systems. With design focused squarely on the service rendered to the individual, HighRoad Monorail provides rapid travel and minimal in-station wait time for the rider. Because each vehicle is independently propelled, the number of vehicles trained together is limited only by the station size desired. However, smaller stations allow for easier integration into urban areas, with no more square footage used than a typical local bank branch. While maintaining overall people moving capacity needed by most communities, it uses mostly pre-existing rights-of-way, computer technology, and simplicity of design to minimize costs. As a result, communities can afford to serve a greater area and more accessibility for individuals. Passengers will experience fast, frequent and consistent service, riding in comfort at an affordable price.

COSTS

Money is the one factor that defines the long-term success or failure of a transit system. Despite the need to clean up air, soil and water pollution, money seems to be the most important part... How much will it cost to build? How many people riding it will be required to pay for its operation? Will we need to apply for a governmental subsidy?

Not only does HighRoad Monorail excel at people-moving performance, but at one-fifth of the cost of heavy rail and half the cost of light rail, it is among the most affordable systems today.

When comparing costs, it is difficult to make certain that the cost data include the same items. Many system manufactures shy away from complete disclosure due to their high costs. Although ANY project of this scope will be costly, we believe the customer will find the HighRoad Monorail costs very low when compared to other transit systems of comparable capacity. We so strongly believe in our numbers that we are willing to present them for your review:

The costs shown in our estimates include controls, security systems, emergency power supply construction overhead & profit and patent licensing fees. The costs DO NOT include right-of-way costs nor utility relocation costs due to the wide fluctuation of these regional costs. Because the system is generally elevated, its right-of-way and utility costs will be lower than other "at-grade" systems.

Design and costing is OTG business. We are confident in our costing because we have used predictable design techniques and technologies which are standard in the construction industry and because other professional engineers have reviewed and critiqued our efforts. AND, we are conservative in our estimates. We would rather be faulted for estimating costs too high, than too low.

Frequently Asked Questions and Answers

Q: How can you provide the system since you have never build such a system before?

A: HighRoad Monorail is a technology available for licensing. Cities, counties, or other entities can license the technology, then require that consulting engineers design it and general contractors build it to the designer's specifications. Or a design-build team can license the HighRoad Monorail technology and offer it to cities, counties or other entities to meet their requirements for rapid transit. Such a team has been formed in Georgia called the Georgia Monorail Consortium Inc.

Q: Why does the HighRoad Monorail Rapid Transit Systems cost only half that of many other systems?

A: It uses only one monorail beam; it uses only a fraction of the land required for other systems; stations are smaller and more efficient; it uses smaller power supplies because of its unique design; it uses new but proven technologies and forgoes the mistakes of the past.

Q: How do we know that cost estimates are accurate?

A: Experienced construction engineers, manufacturers, and contractors have reviewed the costs and agreed with the estimates; the costs are verified by using national cost estimating references and methods (RS Means construction cost reference)

Q: Where is a system in operation?
A: Due to the scale of the costs involved in building a "demonstration track" we have not build one. By the same reasoning, you will notice that major aircraft manufacturers don't have a storefront window to which to display their ready made products in hope of a future purchase. It is just not feasible. Today, automobile and aircraft manufacturers are producing and even testing "virtual vehicles" within computers before constructing the first one. This results in greatly reduced final development cost and a more thorough design. It is our belief that such testing of the HighRoad Monorail system design will result in a solution of extremely low final development cost. The "off the shelf" components, however, are used daily in other applications.

Q: Why should we use a technology not yet built instead of the proven light rail or other technology?

A: Light rail, Metro, and other technologies are proven to cost more, to provide less service, to be more disruptive, and to require operation subsidies. HighRoad Monorail costs less, ,provides better service for the masses of people as well as the individual; is far less disruptive during construction, and requires no operation subsidy. This has been validated repeatedly by other engineers' reviews.

HIGHROAD RTS AND HEAVY RAIL TRANSIT SYSTEMS

General: Heavy rail transit systems have been in use world-wide for over 110 years, offering low-speed large capacity transit for use principally in high density urban settings. At-grade tracks in dedicated rights-of-way offer relatively safe pathways, but are very expensive and divide communities. Underground tracks in subway systems provide less intrusion into heavily-populated areas, but are exceptionally costly. In contrast, dual-sided monorails are a newer type of transit which provide vehicles running on opposite sides of a single elevated guideway located above the city streets. Since right-of-way usage is minimized, system flexibility is maximized and disturbance to the community during construction is minimized. Consultants and officials who must select a locally preferred technology must make comparisons of all feasible alternative systems. As a prospective feasible alternative, the Owen Transit Group, Inc. (OTG) HighRoad Rapid Transit System (RTS) is presented in comparison with a generic type of late model heavy rail system. Data used is from openly published sources. These pages are to define some of those system distinctive features.

Performance and Speed: Both HighRoad and heavy rail systems offer 70 mph service. However, because of distances required for accelerating and stopping a heavy rail system usually provides stations for passenger access at up to three mile intervals. In contrast, the HighRoad stations are located at distances of ½ to one mile, bringing station access closer to passenger origins and destinations. Where a large 10-car heavy rail train can carry as many as 1,800 passengers at a three-minute headway, resulting in capacity of 36,000 passengers per direction per hour, the HighRoad system uses one or two vehicles of 120 passengers each arriving/departing from small stations at short intervals. As brief as 15 second headway intervals can be achieved by using a patented extended dwell time procedure, resulting in as many as 57,600 passengers per hour per side with a two-vehicle consist. By comparison with heavy rail, the HighRoad RTS can exceed its capacity in extremely dense urban settings.

For intercity and commuter rail service the HighRoad Silver Bullet and HighRoad Silver Commuter are designed for speeds up to 214 mph. Maximum gradient possible with heavy rail systems is usually about 2 %, limited by horsepower and brakes. The HighRoad RTS is capable of up to 7 % grades, made possible by its high horsepower motors and its multiple braking systems.

Capital Cost: Published costs of the HighRoad RTS in the United States is in the range of \$35 to \$39 million per mile(\$22 to 24 million per kilometer), depending on number of vehicles, stations, and topography. Estimated costs include right-of way and utility relocation allowances, design fees and licenses. Heavy rail costs vary from a low of \$200 million a mile (\$ 120 million per kilometer) to as high as \$250 million a mile (\$ 155 million per kilometer), depending on terrain and stations. Based on the lower of both systems' cost ranges, the HighRoad RTS costs one-fifth as much as heavy rail while providing the same or better service.

Operating Costs: The A-C powered HighRoad RTS operating costs are estimated to be less than the heavy rail costs due to the lighter vehicle weight energy use and the automated controls. Additionally, some D-C powered heavy rail vehicles have added power costs associated with converting AC power to DC power. As a result of the lower operating costs, the HighRoad RTS can more easily cover its costs from farebox revenues and not require additional operating subsidies.

Vehicles: Heavy rail vehicles are designed primarily with steel or aluminum. The HighRoad RTS vehicles are designed with advanced lightweight composites and use existing, proven components for its construction. These include proven-in-service doors, air conditioning, motors, solid-state power controllers, signal controls, security systems, and pneumatic braking components. Heavy rail vehicles have been in use for many years and its components are proven in service.

Both the HighRoad RTS and heavy rail vehicles have very large panoramic windows on both sides of the vehicle, making the passenger trip more enjoyable. In emergency evacuation procedures, heavy rail passengers can step down to grade. The HighRoad RTS windows on the guideway side are hinged for passengers or rescue personnel to access the top of the guideway in the event an evacuation is needed. This window arrangement also allows another vehicle to attend a stopped vehicle on the guideway and transfer personnel from one vehicle to another.

Propulsion: The HighRoad RTS system uses standard AC electric motors with digital solid-state VFD (variable frequency drive) controls to provide smooth accelerations, including short-term motor overloading, increasing horsepower for acceleration and climbing grades to double that of conventional motors. Heavy rail vehicles usually have DC electric motors and receive power from an overhead trolley wire. In some cases an at-grade third rail is used for heavy rail power instead of the usual overhead wires above the tracks. Recently some systems have been converted to use AC power.

Braking: Each HighRoad RTS vehicle uses regenerative AC motors and solid-state controls to provide 100% braking during normal operation. In addition, the HighRoad RTS vehicle has two 100% stand-by pneumatic fail-safe auxiliary friction braking systems which apply braking to a fixed braking rail on the guideway, avoiding potential loss of brakes by "heat fade". All three systems are used to provide for emergency braking. The added braking capability of the HighRoad RTS system allows safe descent of steeper gradients. The pneumatic brake systems on the HighRoad RTS are redundant and fail-safe, so that in the event of power failure or loss of pneumatic pressure the vehicle will quickly brake to a full stop. Heavy rail braking systems usually use friction pads applied to the wheels or brake disks and are restricted to small grades.

Tracks and Guideway: There are major differences in the two systems. Heavy rail vehicles usually run on parallel sets of tracks, or use one set of tracks with passing turnouts and operator-controlled passing waits. Heavy rail wheels are steel which run on steel rails. Sound-deadening of the heavy rail system rails and support structure is difficult due to the use of flanges on the wheels which rub on track sides to keep the vehicle on the rails.

The HighRoad RTS operates on rails attached to a high-mass concrete beam and uses sound-deadening material for the "Quiet Rail" patented rail surface interface with the concrete. The HighRoad system of three-wheel connection provides a non-derailable attachment to the guideway and eliminates flange grinding with no-flange wheels. Additionally, the drive wheels and the top rail of the HighRoad RTS guideway are protected from snow and ice accumulations by the overhanging top of the guideway, and can have heat tracing wire to de-ice the rails during time of icing or snow.

Stations: The standard size for a HighRoad RTS station is 45 feet long (about 15 meters), with a typical 130 foot combined width (40 meters), determined by the standards of the National Fire Protection Association (NFPA/ANSI-130 and NFPA-101), security and personal safety requirements, and compliance with the Federal Law governing accommodations for persons with disabilities (ADA). HighRoad RTS stations are accessible from each side of the station and accordingly have two sets of stairways and elevators.

In contrast, the heavy rail stations are accessible at stations usually about ten cars long. Stations are frequently located away from roadways since boarding would interfere with traffic and make center-of-roadway boarding hazardous to the passengers. The smallest heavy rail station would be the length of the train sets up to several hundred feet long. Elevated stations are not used often because of the very high cost of elevating the two sets of tracks.

The heavy rail stations at grade frequently are very expensive, usually costing $50 million or more each. Adding stations to an existing track system without interruption of service or modification of the track would be very expensive.

Power and Controls: The heavy rail system usually uses high voltage DC power for main traction, with power delivered by a suspended wire above the tracks accessed by a trolley pantograph. The HighRoad RTS uses a widely available voltage (480/277 Volt 3-phase AC) for supplying power by means of dual pantographs running on power bars located beneath the guideway top overhang. The HighRoad RTS station embodies an auxiliary power generator to maintain the station in full operation (elevator, lights, security, guideway doors) and provide partial power to the guideway power bars for safety power to the vehicles. On-board UPS (uninterrupted power source) batteries are provided in the HighRoad vehicles for continued safe operation of controls even during an extended power shut-down.

Safety: The shape of the HighRoad RTS guideway provides a wide, flat surface on the top for an emergency walkway accessible from a stopped vehicle in accordance with NFPA/ANSI-130. Additionally, this same guideway top surface allows a rail-guided emergency vehicle (such as an Emergency Medical Service or Fire Department vehicle) to quickly reach passengers in the vehicle. This vehicle can also be used to push a disabled vehicle to a nearby station or service area. The heavy rail tracks are usually accessible by means of the adjacent roadway, except when a grade separation or subway tunnel is used.

Materials used in both vehicles must comply with the Federal Transit Administration standards for fire and smoke safety criteria. Both vehicles must provide for emergency telephones for passenger use, and have emergency voice speakers for safety instructions to the passengers. The HighRoad RTS vehicle also has real-time television cameras and sound monitoring in the cabin for continuous remote monitoring by security officers. Heavy rail vehicles have operators on board.

Conclusion: Each of the two systems discussed above offer advantages to the public. The variances between systems offer officials who are charged with system selection a choice between modes (heavy rail or monorail) which offer clearly distinctive differences.

The above information was obtained from published articles and the manufacturer's web sites.

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HIGHROAD RAPID TRANSIT SYSTEM AND LIGHT RAIL TRANSIT SYSTEMS

General: Light rail transit systems have been in use world-wide for over 110 years, offering low-speed light capacity transit for use principally in high density urban settings. At-grade tracks offer very convenient passenger loading points, but require consideration of conflicts with automobiles and pedestrians, a minor consideration at the time light rail was introduced as "streetcars" in the 19^{th} century. In contrast, dual-sided monorails are a newer type of transit which provide vehicles running on opposite sides of a single elevated guideway. Since right-of-way usage is minimized, system flexibility is maximized and disturbance to the community during construction is minimized. Consultants and officials who must select a locally preferred technology must make comparisons of all feasible alternative systems. As a prospective feasible alternative, the Owen Transit Group, Inc. (OTG) HighRoad Rapid Transit System (RTS) is presented in comparison with a generic type of late model light rail system. Data used is from openly published sources. These pages are to define some of those system distinctive features.

Performance and Speed: Both HighRoad and light rail systems offer 70 mph service, however, the light rail system running at grade in traffic will be limited to the adjacent traffic speed except in very expensive separated grade alignments. The HighRoad system uses one or two vehicles of 120 passengers each arriving/departing at short intervals. As brief as 15 second headway intervals can be achieved by using a patented extended dwell time procedure, resulting in as many as 57,600 passengers per hour per side with a two-vehicle consist. By comparison with heavy rail, the HighRoad RTS can approach the capacity of heavy rail in extremely dense urban settings. The light rail system usually is a single car manually operated, with as many as 165 passengers each, but can be operated in 5-car trainsets of 825 passengers total capacity. For intercity and commuter rail service the HighRoad Silver Bullet is designed for speeds up to 214 mph.

Maximum gradient possible with light rail systems is usually about 2 %, limited by horsepower and brakes. The HighRoad RTS is capable of up to 7 % grades, made possible by its high horsepower motors and its multiple braking systems.

Capital Cost: Published costs of the HighRoad RTS is in the range of $35 to $39 million per mile, depending on number of vehicles, stations, and topography. Estimated costs include right-of way and utility relocation allowances, design fees and licenses. Light rail costs vary from a low of $17.25 million a mile to as high as $78.8 million a mile, depending on terrain and stations. A recently constructed light rail system in Dallas, Texas cost approximately $41 million a mile, according to the Federal Transit Administration.

Operating Costs: The A-C powered HighRoad RTS operating costs are estimated to be less than the light rail costs due to the lighter vehicle weight energy use and the automated controls. Additionally, the D-C powered light rail vehicles require added power costs associated with converting AC power to DC power. As a result of the lower operating costs, the HighRoad RTS can more easily cover its costs from farebox revenues and not require additional operating subsidies.

Vehicles: Light rail vehicles are designed primarily with steel or aluminum for at-grade crash protection. The HighRoad RTS vehicles are designed with advanced lightweight composites and use existing, proven components for its construction. These include proven-in-service doors, air conditioning, motors, wheels, solid-state power controllers, signal controls, security systems, and pneumatic braking components. Light rail vehicles have been in use for many years and its components are proven in service.

Both the HighRoad RTS and light rail vehicles have very large panoramic windows on both sides of the vehicle, making the passenger trip more enjoyable. In emergency evacuation procedures, light rail passengers can step down through doors to grade. The HighRoad RTS windows on the guideway side are hinged for passengers or rescue personnel to access the top of the guideway in the event an evacuation is needed. This multiple window arrangement also allows another vehicle to attend a stopped vehicle on the guideway and transfer personnel from one vehicle to another.

Propulsion: The HighRoad RTS system uses standard independent AC electric motors with digital solid-state VFD (variable frequency drive) controls to provide smooth accelerations, including short-term motor overloading, increasing horsepower for acceleration and climbing grades to double that of conventional motors. Light rail vehicles usually have DC electric motors and receive power from an overhead trolley wire. In some cases an at-grade high voltage electric third rail is used for light rail power instead of the usual overhead pole-supported wires over the tracks.

Braking: Each HighRoad RTS vehicle uses regenerative AC motors and solid-state controls to provide 100% braking during normal operation. In addition, the HighRoad RTS vehicle has two 100% stand-by pneumatic fail-safe auxiliary braking systems which apply braking to a fixed braking rail on the guideway, avoiding potential loss of brakes by "heat fade". All three systems are used to provide for emergency braking. The added braking capability of the HighRoad RTS system allows safe descent of steeper gradients. The pneumatic brake systems on the HighRoad RTS are redundant and fail-safe, so that in the event of power failure or loss of pneumatic pressure the vehicle will quickly brake to a full stop. Light rail braking systems usually use friction pads applied to the wheels and are restricted to small grades.

Tracks and Guideway: There are major differences in the two systems. Light rail vehicles usually run on parallel sets of tracks at grade or elevated, or use one set of tracks with passing turnouts and operator-controlled passing waits. Light rail wheels are flange-type steel which run on steel rails. Sound-deadening of the light rail system rails and support structure is difficult due to the use of flanges on the wheels which grind track sides to keep the vehicle on the rails.

The HighRoad RTS operates on flat rails attached to a high-mass concrete beam and uses sound-deadening material for the "Quiet Rail" patented rail surface interface with the concrete. The HighRoad system of three-wheel connection provides a non-derailable attachment to the guideway and eliminates flange grinding with no-flange wheels. Additionally, the drive wheels and the top rail of the HighRoad RTS guideway are protected from snow and ice accumulations by the overhanging top of the guideway.

Stations: The standard size for a HighRoad RTS station is 45 feet long, with a typical 130 foot combined width, determined by the standards of the National Fire Protection Association (NFPA/ANSI-130 and NFPA-101), security and personal safety requirements, and compliance with the Federal Law governing accommodations for persons with disabilities (ADA). HighRoad RTS stations are accessible from each side of the station and accordingly have two sets of stairways and elevators.

In contrast, the light rail stations are accessible at many convenient points at grade. Stations are frequently located away from roadways since boarding would interfere with traffic and make center-of-roadway boarding hazardous to the passengers. The smallest light rail station would be the length of the vehicle or of trainsets up to several hundred feet long. Elevated stations are not used often because of the very high cost of elevating the two sets of tracks.

The light rail station at grade would likely cost less for construction, could be added to an existing track system without interruption of service or modification of the track, as could the HighRoad RTS.

Power and Controls: The light rail system usually uses high voltage DC power for main traction, with power delivered by a suspended wire above the tracks accessed by a trolley pantograph. The HighRoad RTS uses a widely available voltage (480/277 Volt 3-phase AC) for supplying power by means of dual pantographs running on power bars located beneath the guideway top overhang. The HighRoad RTS station embodies an auxiliary power generator to maintain the station in full operation (elevator, lights, security, guideway doors) and provide partial power to the guideway power bars for safety power to the vehicles. On-board UPS (uninterrupted power source) batteries are provided in the HighRoad vehicles for continued safe operation of controls even during an extended power shut-down.

Safety: The shape of the HighRoad RTS guideway provides a wide, flat surface on the top for an emergency walkway accessible from a stopped vehicle in accordance with NFPA/ANSI-130. Additionally, this same guideway top surface allows a rail-guided emergency vehicle (such as an Emergency Medical Service or Fire Department vehicle) to quickly reach passengers in the vehicle. This vehicle can also be used to push a disabled vehicle to a nearby station or service area. The light rail tracks are usually accessible by means of the adjacent roadway, except when a grade separation is used.

Materials used in both vehicles must comply with the Federal Transit Administration standards for fire and smoke safety criteria. Both vehicles must provide for emergency telephones for passenger use, and have emergency voice speakers for safety instructions to the passengers. The HighRoad RTS vehicle also has real-time television cameras and sound monitoring in the cabin for continuous remote monitoring by security officers. Light rail vehicles have operators on board.

Conclusion: Each of the two systems discussed above offer advantages to the public. The variances between systems offer officials who are charged with system selection a choice between modes (light rail or monorail) which offer clearly distinctive differences.

The above information was obtained from published articles and the manufacturer's web sites.

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HIGHROAD SILVER BULLET AND HIGHROAD SILVER COMMUTER

General: Commuter Rail is the term used to describe passenger trains operating on low-speed rail lines usually shared with freight lines serving a city. Trains run at high usage times, usually limited to mornings and evenings which serve workers in the city by giving convenient access to their suburban homes. Average times for commuter rail service from points 30 miles (50 kilometers) from the city center are estimated to be one hour, controlled by conflicts with freight train schedules and an average line speed matching that of freight trains. Commuter rail, therefore, does not compete well with the convenience of an automobile for the same 30 mile (50 kilometer) trip.

An alternative plan, proposed by Owen Transit Group, Inc., provides high speed HighRoad Silver Commuter dual-sided elevated monorail service by combining it with the 214 mph or 345 kph intercity high speed monorail HighRoad Silver Bullet on the same guideway. It allows commuter passengers a very high speed service to and from the city center while having the option of traveling to distant cities. The very high speed Silver Commuter averages over 100 mph or 160 kph and competes favorably with the automobile by being much faster and more comfortable.

Comfort: The Silver Commuter guideway is an elevated concrete track-beam. Vehicles use tilting-cabin technology for increasing passenger comfort on curves. Each vehicle is equipped with high comfort seating and steward and galley service (coffee and snacks) can be made available for commuters as well as for intercity travelers. A toilet is provided for convenience.

Safety: Commuter rail, running at grade and with numerous intersections with automobile/truck traffic has a history of frequent accidents and derailments. Silver Commuter technology is an adaptation of existing automated elevated rail systems which have run for years without safety problems. The elevated Silver Commuter systems will have fewer safety problems than commuter trains. A special feature of the Silver Commuter system is three levels of braking which allow an emergency braking rate of 3/10 g, or 9.6 fps/s, (2.92 mps/s) allowing a very high rate of stopping.

Performance: Whereas commuter trains can average about 30 miles per hour (48 kph), a Silver Commuter system with station stops each 6 miles will average over 100 mph (160 kph). Total time of travel for a 30 mile trip (48 km) approaches 60 minutes for a commuter train, and 18 minutes for a Silver Commuter monorail. However, to these times must be added the passenger's waiting time in the station which varies according to the frequency of departure. Frequent departures increase the average speed of the passenger. Since a Silver Commuter vehicle can depart almost 10 times as often as the commuter train, it will deliver the average passenger to his destination much faster than commuter rail, and provide a higher level of convenience and flexibility for the passengers throughout the day.

Capital Cost: A 30 mile (48 kilometer) Silver Commuter high speed monorail line is estimated to cost about \$30 million a mile (\$19 million per kilometer), including all stations, guideway, maintenance facility, and vehicles. Using a cost estimate of \$10 million a mile (\$6.2 million per kilometer) for standard commuter rail (for track improvements, stations, trains, etc.) as a starting point, the cost for a high speed commuter rail/intercity rail is low. However, to this cost must be added the annualized cost of operating subsidies, greatly increasing the actual cost of the system. With a Silver Commuter monorail line, the first 30 miles can be the first leg of a longer intercity line. This allows planners to reduce the costs of the high speed intercity Silver Bullet line by eliminating the cost of the guideway and stations already in place for the commuter line which is shared by both systems.

The high speed Silver Commuter would have the added advantage of much greater service to passengers due to its high speed, its much more frequent schedule, its added comfort and safety, and its potential for connection to distant cities. With a commuter utilization of 13,000 per day (6,500 each way) and a fare of 30 cents per mile, the Silver Commuter could pay for most of its cost through state or local revenue bonds, with no state or local tax increases. With a commuter utilization of 25,000 per day (12,500 each way) and the same fare, the Silver Commuter could pay off revenue bonds for the entire system, with no Federal involvement or state and local tax increases.

Operating Subsidy: Operating costs for commuter trains are not known, nor are subsidies for overcoming commuter train operating losses. Estimated cost for operating the Silver Commuter is $168 per vehicle hour, much less than the revenues earned from operation. Using a competitive fare of about 30 cents per mile for the commute, net revenue could pay for all system operating costs. Subsidies would not be required.

Conclusion: Based on capital costs, operating subsidies, and construction cost reimbursement, the Silver Commuter high speed rail system offers a better passenger service and investment opportunity. Assuming continuing subsidies from Government would be required to support commuter trains, the Silver Commuter offers the added advantage of not requiring added annual subsidies over the life of the system.

The above information was obtained from published articles and the manufacturer's documents.

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HighRoad Technical and Management Briefing Book

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HighRoad Technical and Management Briefing Book

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1.0 Overview

The HighRoad Rapid Transit System (RTS) is an elevated bi-directional monorail for conveying passengers along each of the two sides of a single beam instead of requiring two separate beams. Classified as automated guideway transit (AGT) technology, the HighRoad RTS is designed to fulfill the requirements for transit systems. Its capacity for carrying people is comparable to that of heavy rail systems, and its speed is similar as well. Cost of designing and constructing a system is approximately one-half that of a light rail system with similar capacity, throughput, speed, and safety. This cost is approximately one-fifth that of a heavy rail system of similar capacity and speed characteristics and less than comparable bus systems when costs of operation are considered.

By providing a convenient and rapid form of transportation which offers a wide selection of destinations (because of more miles constructed per available dollar), the benefits to the users for this system are likely to attract a large number of riders from practices of automobile use. Construction methods used cause fewer disruptions during construction and result in shorter construction schedules and lower costs by reducing capital costs, interest expenses, and right-of-way expenditures.

The lower cost of construction and operation of the system allow all operating costs to be recovered from the fare box, eliminating need for local or national subsidy.

This lower cost also allows, with sufficient ridership, in addition to the operating cost recovery, to recover costs of construction normally paid for by the local community, making the system free of cost to the government and free of a need for operating subsidies.

2.0 Technology

A HighRoad Rapid Transit System uses a single continuous elevated bulb-T-shaped guideway beam (6.5 feet wide x 6.75 feet high with a 6.5 foot wide base) to support special transit vehicles locked onto both sides of the guideway. Lower costs result from construction savings in guideway, smaller stations, lighter vehicle weight, lower horsepower motors, existing digital control technology, and its principles of operation. The systems are covered in U. S. Patents 4,690,064 and 6,321,657.

2.1 Principles of Operation

The HighRoad RTS provides single vehicles on each side of a two-sided guideway with headways (arrivals) as short as 15 seconds, but typically in the one-to-five minute headway range. High frequency of service allows a high throughput of passengers without using trains of connected vehicles at relatively long headways. This high frequency allows smaller electrical power systems on the guideway to serve repeat usage by repeat vehicles instead of requiring large electrical power systems to serve multiple vehicles (as in a train) at infrequent intervals. The high frequency vehicle arrival and departure rate allows a small station to serve the passengers of a single vehicle instead of a very long station platform required to serve a train. Using both sides of a single monorail beam maximizes the usage of the beam and lowers construction costs. This arrangement emulates the capacity of trains of 3 or 4 car monorails with 300 seats or spaces per train, but at lower costs and higher service to the passengers.

2.2 NFPA/ANSI-130 - Fixed Guideway Transit and Passenger Rail Systems (2000 Ed.)

This Standard of the National Fire Protection Association, adopted both by ANSI and many states, prescribes important features of system installation and operation pertaining to life safety. The details of this code are incorporated into the design of the HighRoad RTS in order to maintain passenger safety and comply with State requirements. By following the NFPA-130 standard persons can readily leave the vehicles to access the top of the guideway, allowing rapid and safe means of removal to another vehicle or to a safety location away from the vehicle.

2.3 Guideway Beam and Columns

Guideways use pre-cast, pre-stressed and post-tensioned concrete structures formed in the shape required for the system. Casting methods include using flexible beam curve forms to allow guideways which comply with the precise horizontal and vertical curvature of the route. Long beam segments are cast independently, cured, and transported to the erection point for post-tensioning and installation. Interiors of guideways are made available for insertion of conduit for controls and power wiring. Overhanging portions of guideway top sections are used for attachment of solid copper power bars and for installation of drive wheel rails. Overhangs protect electrical components and drive wheel rails from weather effects. Lower portion of guideway (base section) supports the rails used for the vertical load idler wheels and supports the rails used for the horizontal moment idler wheels. Weight of the guideway is used to counter the cantilevered weight of two fully-loaded two-vehicle consists with 100% safety reserve. (Figure 2.3.1) Columns are fabricated in place or cast off-site as pre-stressed structures for transport and insertion into a concrete foundation "socket" for rapid installation.

2.4 Guideway Construction

Construction is begun by preparing a foundation of pilings and reinforced concrete as needed for the loads and soils. The foundations are formed for site-built columns or as sockets for pre-cast columns. Pre-cast columns are fixed in place by grouting to control elevation and orientation. Beam segments are assembled at grade, post-tensioned for assembly, then lifted into position on the columns, or installed by segment launching from the completed guideway structure. Isolation pads are installed between the column heads and the beams. Electric power bars and rails are then affixed to the guideway, and power lines installed with connections to multiple transformers located on the columns, at grade, or at the station buildings. A construction rate of 120 feet per day per crew is planned. The rate can be expanded as needed. Construction at a three-crew rate, three shifts per crew, building 900 feet per day, provides one mile of guideway construction for each crew working 25 work days (5 weeks), with allowances for weather. Three crews can construct a minimum of seventy-five miles of guideway per year. Rapid launched construction provides minimum roadway traffic disruption.

2.5 Vehicles

Vehicles are of composite body construction similar in technology to the vehicles used at Disney World in Florida, but with arrangement in accordance with the requirements of the HighRoad vehicle. With dimensions of 45 feet long, 9 feet wide, and 9 feet high, the transit vehicles have the ability to move 120 passengers at 70 mph. The intercity model moves 43 passengers at 214 mph. Windows on the guideway side of the vehicle tilt out in an emergency to provide access to the top of the guideway, bridging the small gap (14") between the vehicle and the guideway. Vehicle bodies are supported from the drive units with pneumatic isolators. Isolators can be inflated or deflated to (a) maintain level position of the vehicle in a station or while moving and (b) tilt the cabin to direct centrifugal forces resulting from high speed motion on curves for passenger comfort.

Interiors of the vehicle are similar to airliner interiors, with all materials fireproof. Floors are anti-slip, with panels as needed to access drive components below. Vertical hand-hold bars are available for passenger convenience. Each of the four sets of doors (two sets for the intercity vehicle) are 4 feet wide, opening simultaneously when at stop in a station. Four locations for wheelchairs (two locations for the intercity vehicle) are provided. Windows are bullet-proof polycarbonate. Sidewalls, floors and ceilings have Kevlar liners for bullet stopping

Video cameras are located in each vehicle for CSS real-time monitoring. Audio microphones are located in each vehicle for CSS real-time listening. Each vehicle has one emergency telephone with direct access to the CSS. Each vehicle has an audio speaker for CSS announcements to the vehicle.. The nose section is used for housing control units and radio transmitters/receivers. External lighting is a fixed white light on the nose and two fixed rear red lights. Onboard vehicle power is 277 Volts and 120 Volts obtained from a transformer on the drive unit. Emergency lighting is provided for one hour by battery back-up in some lighting units. Emergency power to the controls is provided for one hour by independent UPS battery back-up and spike/surge filtering devices.

2.6 Drive Units

Drive units are steel welded assemblies locked onto the guideway side which support the vehicle cabins and carry the motors, wheels, mechanical rail brakes, air compressors, air conditioning compressors, pantographs, transformers, power controllers, disconnects and interconnecting wiring. Two separate drive units are provided per vehicle, providing 100% emergency backup for the propulsion of the vehicle. Drive units are interchangeable and modular, mechanically and electronically interconnected.

2.7 Motors

Standard electric drive motors by Siemens are designed to be controlled by solid-state controls utilizing wave-forms which allow smooth regulated starts, variable acceleration, and specified speed control for the vehicle. Motor controls are designed to be supervised by external computers using the Siemens Simatic Control System. Short term motor overloads of up to 200% are allowed without degradation of the motors. Motors are standard frame, base-mounted and VFD managed to control the speed of the drive wheels. Selected motors are designed for 480/277 Volts, 3-phase. Motors are totally enclosed fan-cooled types with auxiliary blowers to dissipate heat more efficiently.

2.8 Acceleration and Deceleration

Acceleration is limited to .1g, or 3.2 fps/s (1 m/s/s) by accelerometer and motor power control system acceleration curves. Deceleration is limited to .1g, or 3.2 fps/s by decelerometer and brake control deceleration curves. Emergency deceleration is 10.47 fps/s (7.13 mph/s) by simultaneously using three independent braking systems (regenerative motor braking, forward and rear drive units mechanical braking) controlled by the automatic control system. Emergency transit stopping distance at full load (120 passengers) and full speed (70 mph) is 503 feet (approx. 1/10 mile). Normal stopping distance is 1,251 feet (approx. 1/4 mile). The intercity vehicle, at full load, can stop in 1.2 miles from 214 mph.

2.9 Power

Electrical power is 480/277 Volts, 3-phase. Power to the vehicle is distributed through rigid bus-bars mounted on the underside of the guideway overhang for takeoff by dual sets of pantographs. Four bus-bars are provided. High voltage power (voltage determined by the providing utility) is distributed to the bus-bars after transforming to 480/277 V by transformers in the stations, at grade, or mounted on the guideway columns. High voltage supply power can be distributed in the core of the guideway or on power utility poles (or underground) from the providing utility grid through columns or stations. Dual power sources are provided for the transit vehicle by the providing utility. Emergency power to the stations is available from generators located in the station buildings. Power in the stations for station lighting is 277 Volts, with 480 Volts for elevator operation. Other equipment requiring 120 Volts are provided for by single phase transformers in the stations.

2.10 Braking

Primary braking is by use of regenerative means through the drive motors with retarding force exerted by the steel drive wheel on the steel drive rail. This allows a braking force providing .1g deceleration (3.2 fps/s) to the drive unit. Additionally, each of the two drive units has a pneumatic retard/spring applied emergency brake system which applies a braking deceleration of .1g to the vehicle, for a total of 10.47 fps/s braking deceleration. Retarding force is applied by an air supply of 100 psi to two 5" diameter Goodyear pneumatic actuators in each brake enclosure which act to compress springs while retracting brake shoes from the lower idler rail. Brake shoes in the brake enclosures (4 per bogie) are normally retracted, but upon command from the braking system air pressure in the retarding actuators is reduced and the springs then are released to apply force to the brake shoes which apply pressure to the lower idler rail and thereby retard the vehicle. This fail-safe arrangement allows .2g braking immediately upon loss of electrical power if selected as an emergency function. The lower base rail which has the brake shoe forces applied to it acts as a moving heat sink for absorbing braking energy, preventing the build-up of heat in the brake shoe which can cause "brake fade". (Figure 2.10.1)

2.11 Controls

Controls utilize the Siemens Simatic system in which multiple computers using the Windows NT platform access predesigned and debugged subroutines within each computer to execute digital commands to controlled components. For safety, the initiation of an action command is sent to two on-board computers which independently calculate a resulting digital command. A third computer compares these commands and if both digital commands are identical, then it forwards the digital commands to controlled components. Failure of the two computers to agree results in the third computer directing the vehicle to stop (if it is a safety item) and notifies the CSS of a controls failure. CSS can then command the vehicle to proceed to a location where the failure can be repaired, or take such other action as is required.

The control systems are overridden by external moving block controls which govern the use of a guideway location by a vehicle to prevent two vehicles occupying one space simultaneously. Moving block size is governed by the safety limitations for vehicle stopping or slowing to maintain vehicle separation. Using .1g braking, stopping distance at maximum speed is 1,251 feet, requiring 27.9

seconds to full stop. Using the additional braking available an emergency stop can be executed in 503 feet. Accordingly, a moving block of approximately 1,320 feet is feasible, with a normal margin of 1,251 feet and an emergency (without regenerative braking) margin of 842 feet.

Systems controlled by the on-board computers are:

Motors (forward/reverse, rpm (speed))
Doors (open/close, safety retract, announce)
Air conditioning (heat/cool, fan on/off, temperature set, compressor)
Auxiliary heating (interlocked with air conditioning)
Lights
Brakes (normal), emergency 1, emergency 2
Air Compressor-Brakes
Air Compressor-Level & Tilt
Leveling (automatic local control feedback)
Tilting (automatic local control feedback from accelerometer)
Video Cameras
Audio Microphones
Station Arrival Announce - Audio & LED Board
Position Reporting to CSS
Tourist Announcement System

2.12 Emergency

There are three general emergency classifications: Braking to Stop, Evacuate, and Disorder on Board. Braking to Stop has been covered in the paragraphs above. Evacuate is a command given by voice from the CSS when required. This voice instruction will be given over the vehicle announce system to advise passengers to depart the stopped vehicle by means of the guideway windows. Disorder on Board will be another reason for the CSS to make a voice announcement over the vehicle announce system. This can be used to advise unruly passengers of penalties for disturbing the system operation. CSS personnel can dispatch police to handle disorders and can direct a vehicle with problem passengers to a station for police attention.

2.13 Communication

Communication to and from the vehicle is for: (1) CSS announcements, (2) CSS passive listening, (3) Video imaging from the moving vehicle, and (4) Passenger-accessible Emergency Telephone link to the CSS. Communication is through using optical send/receive units on the vehicle and on the guideway at intervals. Cabling is selected to avoid problems from pantograph sparking interference with radio links. Siemens communications equipment is used for all links.

2.14 Pantographs

Power take-off pantographs are used to get electrical power from the four power bus-bars on each side of the guideway to the drive controllers on each drive bogie. Three phase power requires four contact carbon-shoe points sliding on the copper bus-bars with pressure maintained by spring assemblies on the pantograph. Pantographs are automatically engaged or retracted. Current for motor start-up and continuous motor overload are provided for in the design of the pantograph as well as the power bus-bars.

2.15 Comfort

Each vehicle has ducted air conditioning and heating on board, with heat pump compressors remotely mounted on the adjacent bogie. Flexible refrigerant lines connect the compressors to condensers/evaporators beneath the vehicle cabin, and other lines connect the condensers to evaporator/heating blower units located with their ducting in the ceiling assembly of the cabin. Auxiliary electric resistance heating strips are located in the blower units for supplemental and emergency heating. Panels in the cabin ceiling allow full access to the overhead equipment. Thermostats in the return air system sample the air and provide for full automatic control/reset of temperatures in the cabin. Smoke detectors in the return air system sample the air for smoke hazards and report the presence of smoke hazards to the CSS. Two independent systems are provided. Total capacity of the two systems is approximately twelve tons (144,000 Btuh). Fresh air is provided to comply with ASHRAE and State Codes.

2.16 Seating

Thirty-three forward-facing seats, each 19" wide, are provided to accommodate 27% of the passenger capacity. Standing room is provided for an additional 87 passengers. Space is available for four wheelchairs within the space allocated for standing passengers. Seats are spaced at 30" nominal intervals, but can be designed with thirty-one seats for 32" spacing. Seats can be provided as fiberglass with fabric inserts or as fully-upholstered units. Alternative seating arrangements are available. Intercity vehicles have 43 seats, including wheelchair accommodations, plus an attendant's seat.

2.17 Windows

Windows are provided around the vehicle for 360-degree views. All windows are polycarbonate plastic for hazardous object protection. Guideway-side windows are hinged at the bottom for emergency use as an evacuation route and bridge to the top of the guideway. Windows have integral tinting for reduction of air conditioning loads and passenger protection from glare. The large windows encourage use of the vehicles by tourists.

2.18 Composite Body

Vehicle body designing and manufacturing by AAR Composites is with composite materials which provide for relatively joint-free vehicles having fewer leaks and greater load-carrying integrity. Weight of the bodies is held to a minimum while maintaining rigidity for proper performance. Finish on the weather-side of the composites is smooth, with color molded into the material, making painting unnecessary or optional. The walls of the composites have greater rigidity and resistance to flexure, providing more sound reduction from outside sources than do other materials. Protection from fire is afforded by the composite materials which have been compounded from self-extinguishing or fire-retarding materials.

2.19 Security

Security of passengers is supported by extensive use of video cameras on the vehicles and in the stations for influencing behavior of others. CSS personnel can address (by voice) interiors of vehicles while in motion or stopped, as well as addressing persons on station platforms. By having small stations (with 50' x 30' platforms) it is easier to monitor activity than with very large platforms. Platforms are well-lighted to approximately 65 foot candles. End walls are glass and open to public view

2.20 Tilting and Leveling

Vehicle cabins are equipped with 100 psi Goodyear air bellows which are inflated and deflated to maintain cabin floors level while in stations and to provide for tilting when needed while in motion to reduce the lateral centrifugal forces on passengers. Four bellows are used beneath the cabin floor, two on each bogie support arm. An air compressor on each bogie provides pressure air for inflation while sensors detect level attitude and centrifugal forces, causing air valves to open or close to maintain the cabin position.

2.21 Switching

Vehicles can be switched from one guideway to another by a swinging guideway beam which moves through a small arc during a 15-second period. Vehicles can be switched from one side of a guideway to another at any point by use of a rotary guideway segment (180 degrees turntable). Ends of guideways do not require turntables if an end loop is utilized to return the vehicle to the opposite side of the guideway.

2.22 Doors

Doors are electric motor driven bi-parting types which retract into the cabin wall adjacent to the door openings. Each door panel has a window section and weather seals. Door motion interruption is provided by infrared sensors which cause retraction and announcement of interference with door closing. Doors attempt closing with announcement until the interference is removed and the doors are allowed to close. Four sets of doors are provided to facilitate the entry and departure of passengers.

2.23 Rails

Steel wheels on the drive bogies which support the vehicle cabin roll on steel rails. Each steel rail is a flat steel plate with interleaving ends for smooth connection. Rails are attached to the guideway in three locations on each side; on the inside of the downturned top section, on the top of the base at the outer edge, and at the lower edge of the outside of the base. The top rail is used for the drive wheel and is the reaction rail for regenerative braking through the drive motor. The upper base rail is for the support of rolling loads caused by vertical idler wheels, and the lower base rail is for the support of rolling loads caused by horizontal idler wheels as well as a braking reaction rail for the friction emergency brakes. Rail attachment is by stainless steel insert anchor bolts designed for vibration and impact conditions.

2.24 Rail Noise/Quiet Rail

Noise from steel wheels on steel rail has been observed on elevated railways and is objectionable. This noise, radiated by contact of the rail with the supporting structure, has been greatly reduced to less than the noise from rubber tires on concrete by the Quiet Rail design of the HighRoad system. This design uses a neoprene seismic pad with variable densities to filter out transmitted noise to the structure. At the same time it provides a damping effect on the rails to stop vibration, and it allows the rails to slightly flex to maintain full wheel contact with the rail surface, equalizing unit pressures on the rails, wheels and brake shoes.

2.25 Grades

Grades possible with any vehicle are limited by (1) slip of the drive wheel on the rail and (2) the horsepower available to accelerate the vehicle on the grade. High horsepower of the HighRoad vehicles allows grades possible up to 10% with a full load. Higher grades are possible with a high-friction or geared track for use on the steeper grade. For planning purposes 7% capacity is preferred. Regenerative braking and partial use of emergency braking is provided for use on down-slopes of steep grades to maintain braking performance similar to level braking.

2.26 ADA

Each transit vehicle can accommodate four wheelchairs (two wheelchairs for the intercity vehicle) which can access the vehicle through four-foot wide doors. A turning diameter of four feet is available in front of each wheelchair position. All station-vehicle interfaces are level and a gap of no more than 1" is allowed. Stations are equipped with one elevator for each side for access to the loading platform and the cross-over platform if so equipped. Turnstiles are provided for wheelchair access to vehicles. Emergency telephones in vehicles and stations are located for convenience to wheelchair occupants.

3.0 System Passenger Capacity

3.1 Headways Effects

With each transit vehicle carrying 120 passengers (intercity vehicle 43 passengers) it is necessary to move many vehicles in order to obtain high throughput. The many vehicles provide passengers with a higher quality of service than do less-effective train systems. Peak capacity is 28,800 pphpd (passengers per hour per direction) with single vehicle consists and 15 second headway. Using two-vehicle consists increases this capacity to 57,600 pphpd, greater than heavy rail. Intercity capacities are 10,320 and 20,640, respectively.

3.2 Separations Effects on Speed

Time used for acceleration from a station and decelerating into a station reduces the average speed of a vehicle in a system. A balance between the speed service of a system and the cost of constructing stations is required. Prospective rider's decisions may be influenced by accessibility of stations to homes and destination points. Low cost stations can be located closer to prospective system users. Since speed, service and convenient access are major elements of marketing and sales which are valuable to the prospective passenger, station locations for convenience must be balanced with project total cost and system effects on average speed.

3.3 Dwell control

Dwell periods of many transit systems are on the order of 15 seconds, measured on three heavy rail systems (London, Paris, Atlanta) as varying from 12 seconds to 17 seconds in normal operation. For the purpose of system analysis, 15 seconds dwell is used for all headways of 30 seconds or greater. For headways of less than 30 seconds an extended dwell procedure is required. This allows three periods within a dwell time: arrival and passenger exit, moving of the vehicle to a boarding position, and passenger boarding. This allows a vehicle arriving 15 seconds after a preceding vehicle to move out of the arrival and exit positions and make room for the following vehicle. Allowing 10 seconds for exit, 15 seconds for vehicle repositioning, and 10 seconds for boarding, a total period of 35 seconds dwell is required. For planning purposes and calculation of passenger throughput, a 45 second extended dwell period is used.

3.4 Consists

Each vehicle can transport 120 passengers (43 passengers for intercity). A typical arrangement for a HighRoad RTS is single vehicle consists for lowest initial construction costs. Two vehicle consists are an option to double passenger throughput. The guideway structure and power system are designed for two-vehicle consists to allow for expansion of capacity without incurring extraordinary expenses. In order to minimize station construction costs for initial operation one vehicle consists are used. Each station can be doubled in size to accommodate two vehicle consists.

4.0 Stations

4.1 Function

Stations have elevated platforms (both sides of guideway) with roof for convenience in boarding monorail vehicles at guideway levels. Elevators are provided for ADA compliance and passenger convenience. Stairs are provided for access and for NFPA/ANSI-130 egress for full vehicle passenger counts. Stations can be configured with a cross-over level to access the opposite side of the guideway. This level is reached by elevator and stairway continuance. End walls are glass for passenger appeal and for security. Guideway and vehicle access is controlled by platform doors which match spacing of doors on vehicles. Doors are designed to open only when a vehicle is at the platform. Toilet facilities are not provided for security reasons, lower construction cost and for operating cost control. Security video cameras are installed and positioned to observe all areas of each platform. Stations are not heated or air conditioned, but platform end walls have open areas for air flow. For two-vehicle consists and for extended dwell operation a double-sized station is required.

4.2 Structural Design

Stations are designed as pre-cast concrete structures for prefabrication and final installation on site-specific foundations. By using prefabricated structural components and as-cast finishes, complete stations can be constructed for less cost and in approximately half the time of standard buildings of similar size. Facades can be designed to blend with community architecture.

Stations, due to their pre-cast construction, may be built on an existing guideway when a need arises. This allows a minimum number of stations to be built originally, with other stations added as needed. The modular construction allows continued traffic on the guideway during construction.

5.0 CSS and Maintenance Facility

5.1 Function

This facility houses three functions, (1) Central Supervising Station (CSS) for real-time control of the system and for security monitoring of all equipment and public locations, (2) Major Maintenance Facility for maintenance functions which cannot be performed on the guideway during non-traffic periods, and (3) General Administration including System Marketing, Personnel, Financial Management, FTA Coordination, and Public Relations. It includes a section of guideway which runs through the upper level for convenient access to major components of vehicles which need servicing or replacement. Size of the facility is a function of the size of the system.

5.2 Structural Design

The CSS and Maintenance Facility is designed as a pre-cast structure for prefabrication and final installation on a site-specific foundation. By using prefabricated structural components and as-cast finishes, complete stations can be constructed for lower cost than standard buildings of similar size.

6.0 Construction Cost (Estimated)

6.1 General

Construction costs per mile generally are reduced as the miles within a system are increased due to certain fixed costs per route being spread over a greater or lesser number of miles. In this section a 28.1 mile route is used as a baseline. Nominal system cost in the United States with a standard 20' high column head is estimated to be $32.3 million per mile, including stations, vehicles, maintenance and administrative facilities, vehicles (for approximately 1 minute headways), and allowances for right-of-way procurement and utility relocation. Costs include contingency allowances and start-up funding, including six months payments reserve.

6.2 Guideway

Project costs include two switches and a short guideway turnout each five miles for supplemental vehicle storage and for emergency vehicle removal from the active guideway. Actual costs may vary from this estimate and will be provided when a specific cost proposal is required for construction contracts. River crossings may be made as elevated independent structures with in-water footings and long spans or as split steel guideways attached to the sides of existing bridge structures. Guideway costs have been priced by a major precast concrete manufacturer, based on post-tensioned beam segments and site-formed columns at 120-feet intervals.

6.3 Vehicles

A standard HighRoad RTS vehicle is estimated to cost $ 1,802,000 including on board controls and security video system. A greater number of vehicles purchased may lower the unit cost, and increased requirements or fewer vehicles may increase the costs. This cost was prepared by a Florida contractor for transit vehicle bodies and a Georgia contractor for steel chassis and final assembly.

6.4 Controls

Controls for a 28.1-mile system are estimated to cost $ 500,000. per mile with a single Central Supervising Station. Longer or shorter systems will change this estimate, as will other details of planning. Controls costs will vary according to specific site design. Controls are based on the Siemens Simatic system for industrial automation, and are fully developed, making use of both digital distributed technology and PLC local management. Controls operation is similar to that used in building systems management.

6.5 Stations

Each single vehicle consist station is estimated to cost $ 2,373,000. Greater or fewer numbers of stations will change the total cost of the system, as will modified function and requirements of station design and system planning. Costs may be increased or decreased according to the construction costs in locations other than the base-line location (Atlanta, GA, USA).

6.6 CSS & Maintenance Facility

The CSS and Maintenance Facility is estimated to cost $ 13,211,000 based on a requirement for 2,000 sf of CSS, 20,000 sf of maintenance facility, and 5,000 sf of administrative facility. Modified function and requirements of centralized maintenance will change this estimate. Costs may be increased or decreased according to the construction costs in locations other than the base-line location (Atlanta, GA, USA).

6.7 Ticketing and Fare Collection

A major cost of existing transit systems is fare collection. Fares have historically been collected at the point of boarding, with cash being the primary medium. This is slow and inefficient. The HighRoad system will use a HighRoad Fare Card for a system-only debit, debiting the card based on the distance traveled, allowing for fast boarding, elimination of fare collection personnel, electronic monitoring of traffic flows, and convenient access to the system by passengers. The HighRoad Fare Card can be used continuously during the day, with discounts given during off-peak hours if desired, and can be electronically changed when fares-per-mile rates change.

The accuracy of proportional distance fare charging makes it appealing to passengers who realize that a ride of one mile would cost only $0.21, whereas a ride of five miles would cost $1.05. Since this is much less than a standard fare of $1.75, a passenger will perceive it as a bargain and is more likely to use the system for short distances as well as for long trips.

7.0 Operating Cost

7.1 Factors

Factors in estimating system operating cost are as follow:

a. Miles of guideway to be maintained
b. Number of stations to be operated and maintained
c. Number of vehicles
d. Hours of operation
e. Cleaning staff
f. Maintenance staff
g. Administrative staff
h. Fuels, expendables
i. Depreciation
j. Insurance
k. Advertising
l. Payroll taxes

7.2 Variable Factors

Operating cost expressed as an hourly cost per vehicle for a 28.1-mile system is estimated to be $129.11. This is a function of all the above factors in 7.1. By operating the vehicles at the highest possible load factor (% of vehicle capacity used) the operating cost per passenger is minimized. Also, by operating the system for the highest possible productive hours per day the fixed annual costs are spread over more hours thereby reducing the average hourly system operating cost. The system's qualities which attract to potential riders (hours, available space, frequency, speed) also increase the system's operating cost. Marginal cost benefit analyses combined with political forces will dictate final service levels and therefore dictate operating costs. Costs will vary from the estimate according to specific locations and conditions.

8.0 Fares and Fare Economics

8.1 Assumptions

Estimated costs are for a prototypical 28.1-mile HighRoad rapid transit system with a given headway of 0.79 minutes and occupancy of system vehicles at 31 % operating for 20 hours a day, and a design speed of 70 mph, with stations at 1.34 miles apart. Vehicles run continuously, reversing to run on the opposite of the guideway when reaching the end of the line. Fare is assumed to be $0.21 per mile (2004) traveled. Average trip is assumed to be 10 miles long. All repair, depreciation and replacement costs are included in hourly operating costs and are not reimbursed from FTA grants, State grants, or sales taxes.

8.2 Operating Cost Break-even

Break-even ridership for the specified system is 114,055 riders per day. This is approximately 4,060 riders per mile per day. Ridership for MARTA heavy rail is approximately 6,250 riders per mile per day, with similar demographics but with fewer stations. The MARTA system operates at a loss with a fixed fare of $1.75 regardless of distance traveled. The typical MARTA line is 11 miles long, radiating from the city center. The prototypical system used in this analysis is 28.1 miles long with three major employment centers at approximately 9 miles separation, and residential centers (ridership sources) between the employment and retail centers (ridership destinations).

8.3 Bonds Retirement Break-even

Ridership is expected to be above the operating cost break-even level. Capital cost recovery is based on a revenue bonds payment of principal and interest at a rate of 5.5% for a period of 30 years. No subsidy or local tax is required. Funds are included in the financing package to cover construction contingencies (5%) and allowances for start-up and a six-month reserve for bonds retirement.

9.0 Monorail Route Planning

9.1 Station Locations

Stations are nominally located one mile apart (closer where principal collection and distribution opportunities exist). Although stations frequently are located in planning by selecting high potential destination sites, it is believed that this arrangement should be modified. Since a rapid transit system is to "move people from where they are to where they want to be", then consideration of where they are must be determined. Residential communities in most suburban cities and towns provide lower density populations than do very compact city centers. However, the serving of low density populations is necessary to provide passenger flow through high density destinations with commercial, educational, entertainment, medical, sporting center and governmental functions. Without picking up passengers in residential areas there will not be the utilization of high density potential stations.

For instance, for a 28.1-mile system, four high density stations each with 10,000 passengers boarding per day must be fed by as many as 18 stations with 4,114 passengers-per-day each. The total boardings will be 114,055 passengers a day, with an average of 114,055/22 or 5,184 passengers average per station per day, an economically viable situation with the HighRoad RTS. This average utilization per station is less than that experienced by large heavy rail transit systems such as the DC METRO and the Atlanta MARTA systems.

9.2 Maintenance

A maintenance facility can be located according to the needs of the system and not restricted to industrial areas (local zoning permitting) because the facility can be totally enclosed with an appearance design similar to an office building. Limitations are that guideway switches are needed to direct vehicles to and from the facility, and these require added space for column supports.

9.3 Loop Circulator

Where it is desired to provide a circulation system for passengers such as in a downtown area , but it is preferred to provide a system dedicated to local purposes only, a loop circulator can be employed as part of a main line return loop. This allows the return loop at the end of a line to guide vehicles on the outside of the loop for main line use, while guiding other vehicles (at different headways) for inside-the-loop operation. Inside-the-loop-circulators could be operated with or without fares, depending on the desires and contributions of the business community. Arriving passengers from the main line system could access the inner loop at no additional charge, while passengers boarding the inside loop wishing to use the main line would enter the main line boarding platform by paying an additional fare.

A loop circulator could be modified to provide for the main line side of the guideway being connected to a continuing main line beyond the loop, while still maintaining the circulating loop. Use of switches could control usage of vehicles on differing line segments by allowing the loop to be either a "return loop" or an "interconnecting loop".

9.4 Guideway Intersections

Guideways can be intersected at stations by using multi-level stations or by using parallel stations at the same level with horizontal interconnecting walkways. This method of interconnection could be used instead of the loop continuation in 9.3 above.

9.5 Shared Guideway

Shared guideways are possible by use of switches connecting two or more main line routes. For future peak performance of guideways and maximizing throughput in later years this might require changing to non-shared guideways. Shared guideways double the usage of that guideway and prevent headways of vehicles from being less than one-half minute. Two guideways with headways of one-half minute each would combine to use a single guideway with headways of 15 seconds, requiring station modification for extended dwell procedures.

10.0 Safety

Safety features of the HighRoad RTS are:

a. Elevated guideways which eliminate collisions with automobiles and pedestrians.
b. Elevated guideways which inhibit vandal intrusion and contact with power bars.
c. Automated control which eliminates human errors by drivers.
d. Emergency egress windows which allow passengers access to top of guideway.
e. Top of guideway access by emergency crews and vehicles allowing quick rescue.
f. Locked-on design which gives protection from accidental or intended derailment.
g. Total operating control by CSS and security personnel.
h. Protection from bullets by vehicle structure and windows.
i. Small, well lighted stations, with security monitored and openly visible platforms.
j. Automatic platform doors which prevent contact with guideway hazards.
k. Continuous video monitoring of vehicle interiors by security personnel.
l. Full compliance with NFPA/ANSI-130

11.0 Additional Features

11.1 Airport Special Vehicle

A HighRoad vehicle designed for added convenience on interconnecting routes to airports is configured with floor-mounted luggage bins for ease in handling carry-on materials while in transit to an airport. Additional overhead bins can be supplied for typical carry-on bags, coats, etc. similar to those used aboard airplanes.

11.2 Intercity High Speed Rail

An intercity vehicle called "Silver Bullet" configured with high horsepower motors for 214 mph speed is configured similar to the airport connector vehicle. Besides overhead bins for carry-on items, the vehicle has a galley for serving of refreshments and on-board toilet with water closet and sink. Headphones for plug-in to receive enroute music or radio programs can be provided. A vehicle attendant assists passengers with refreshments and headphones.

11.3 Freight

Freight containers can be used similar to HighRoad vehicles on the guideways provided that special loading-unloading facilities are provided. These freight vehicles can be used whenever the guideway has available space between passenger vehicles.

12.0 Marketing

12.1 Competition

Primary competition for the HighRoad RTS passenger is the automobile, with its excellent service and convenience. The HighRoad RTS has been designed to offer higher speed, similar comfort, much lower cost, greater reliability, and far more safety than the automobile, and is most likely of the transit system alternatives to attract prospective passengers from their cars. Ideal operation would have a vehicle headway of 2 minutes or less.

Competition for approval by government agencies is with buses, light rail, and heavy rail. All these modes are more costly either from a construction standpoint or from an operating cost analysis. When compared to these mode alternatives, HighRoad offers more value to the public.

In an effort to break through the government agency preference for the above alternative modes which have previously been built and operated, the HighRoad rapid transit system can be offered as a public-private system, with profits for licensing and marketing services being reduced to make the system feasible without government payment or subsidy. In this arrangement the reduced costs are recaptured in later years as earned system operating profit over the life of a 30-year operating license..

In exchange for the receipt of the system from the providers, the government will issue revenue bonds for the construction of the system, guaranteeing the payments due on the bonds for the life of the bonds, and assume all liabilities for payments for the bonds, regardless of system operating revenues. The operating revenues plan allows payments to an operating service for system operation, full payments of all bonds (subject to available cash flow), and a profit to be paid to the providers of the system, subject to a net profit earned from system operation.

12.2 Critical Mass

Where transit systems have been designed and built as short entry-level systems which only serve destinations but not residential passenger sources, success has been limited. A system which serves many origination points (homes) and can carry passengers to most places they want to go can be successful since it will perform the service now provided by the personal automobile. This beginning of adequate origin and destination stations in a system can be described as "critical mass". Until this level of service can be offered to the prospective passenger, the system will be limited in its appeal. Origins should then be selected to provide feeding stations for the more widely-used destination stations, such as:

a. Work places, particularly high density sites
b. Schools, including universities and regional colleges
c. Government buildings
d. Entertainment and Sporting Events sites
e. Libraries
f. Medical Centers and Hospitals
g. Retail sales centers
h. Historical Sites
i. Tourist Attractions
j. Hotels and Motels
k. Convention centers
l. Parks
m. Restaurants

12.3 Micro Commute

When a passenger arrives at a destination station by use of a transit vehicle he has completed his Macro Commute, traveling the greatest part of his trip on the transit system. The final portion of his trip, however, may be the part that is his greatest problem, and frequently the portion that will cause him to continue using his personal automobile. Sometimes this final micro commute will be just a short walk to his destination. Sometimes the walk will be further, but still not sufficiently long to prevent his using public transit. However, many passengers will need further transportation, possibly provided by a shuttle van or a bus. Depending on the schedule for this van or bus and its convenience to his final destination the passenger may be annoyed and not be a convert to public transit.

An alternative method for the micro commute is the Station Car, a vehicle available for rent or long term lease kept at the destination station. This Station Car can be electric, gasoline or hybrid, and be designated for off-Interstate use to allow a final trip from a station for a very short distance or as much as five miles. This gives the passenger better control of his time, protection from inclement weather, and allows the convenience of a personal automobile. It can be used during a day for miscellaneous driving, to be returned to the station at the end of the day. With vehicles such as these used at both ends of the macro commute trip the entire commute can be accomplished with alternative fuels (electricity) and reduce air pollution from automobiles. Low mileage use of these vehicles helps to keep initial costs low and minimizes depreciation.

In addition to station cars, bicycles may be made available on an "honor system" usage or on a rental basis. Also, free locked bicycle parking at stations may allow individuals to provide their own alternative micro commutes.

END

Georgia Monorail Consortium
Transit and Intercity Monorail Systems

Owen Transit Group, Inc.
Aebersold Technologies Corporation
AAR Corporation
Control Corporation of America
Transit Operating Services Company
MACTEC Engineering, Inc.
Tindall Corporation

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Confidence in the "HighRoad" 2nd Generation Monorail Design

Questions and Concerns have be raised over the fact that the "HighRoad" 2nd Generation Monorail Design has yet to be built and proven. To address these concerns, the Georgia Monorail Consortium has prepared the following facts and arguments in support of the HighRoad design.

1. **Technically Proven Components and Services**: The HighRoad Rapid Transit System has not yet been built. However, our consortium of companies have technically proven components and services made by major world-class companies offering high-quality services including:

a. *Vehicles: AAR Composites* built the original Disneyland and Disney World vehicle bodies, as well as the Disney Mark VI vehicles (expanded system) and have completed and installed the Las Vegas monorail vehicle bodies for Bombardier, purchaser of the Disney technology. Our vehicle body will be made in the same plant in Clearwater, Florida as the Bombardier vehicles.

b. *Controls - Control Corporation of America* (CCA) is Siemens' largest US integrator of their controls. We will be using the Siemens Simatic group of controls as presently used in American (and all over the world) factories to control very complex controls. Our control problems are much simpler than many of the factories using the Siemens system.

c. *Power Supplies - Wesco Corporation* (parent of CCA) is a world-wide distributor of heavy industry power management and controls. We have their expertise and a full range of off-the-shelf components.

d. *Auxiliary Power - Cummins Engines* will provide the gas-fired supplemental electrical generators for emergency station operation and main power supply failure replacement. These generator-sets are packaged and sold off-the-shelf. They have been proven in thousands of installations.

e. *Concrete and Stations - Tindall Corporation* will advise us in using a local San Francisco Bay Area concrete casting company for making beams, building stations, and building maintenance facilities. They have build similar structures and highway bridges for the US Government (Interstate Highway System) across the SE USA, and know their concrete technology. Their engineers designed our guideway beam.

f. *General Contractor* – We will select, by competition and qualification, a major contractor to build the guideway system, stations, administration and maintenance facilities, and to bring those facilities into operation with the rolling stock, controls, and power supplies through a thorough commissioning process.

g. *Operating Management - Transit Operating Services Company (TOSCO)* of Atlanta will bring experienced transit systems operators into the team for operating the BART system. The President of Owen Transit Group, Inc. was a member of the Advisory Board of the Cobb County, Georgia Community Transit System (buses).

h. *GMC President and Chairman* has over 46 years in engineering and management. Experience is with General Dynamics (airplane design), U.S. Coast Guard (systems engineering), Lockheed-Martin Co. (project administration, project planning, budgets, and marketing), and as a private engineer in systems design and construction, as well as in the development of the HighRoad technology and the patents relating to the innovations.

When all these elements are considered together, a conclusion can be drawn that our proposal is stronger than any other firm which attempts to compete on quality of product, economy of operation, and overall cost of construction, that are chiefly due to the HighRoad dual-sided monorail technology.

2. Exclusive American Technology: In the United States the Government is prohibited by law from funding any transit technology except for that which has already been built or developed with the support of the U. S. Government. This means that in the USA only old systems can be built, or only systems funded by the United States Government or funded by foreign governments can be built. Accordingly, no American company other than GMC and OTG can offer an American Technology, since the actual practice of the U. S. Government is to not fund development of newer technologies other than maglev.

The HighRoad system components are American-made. The vehicle bodies are to be made in Florida, the chassis assembly will be made in Georgia, as are the controls components, software, and controls engineering. Engineering of the infrastructure installation will be provided by American firms, as will be the Architecture. Construction materials will be made in the United States for installation by American construction firms. Construction management will be provided by American firms, and operation will be by an American firm. This is provided for in the Georgia Monorail Consortium, Inc. group of providing companies.

All other technologies offered in joint venture with US firms are from Canada, France, Italy, Germany, Japan, Korea, Switzerland, Britain, and China.

3. The Alternatives to HighRoad: Any transit system, in order to be reproducible for expansion and sustainable for continued operation in the face of potential tax subsidy resistance by the voters, must have a technology that can be built within expected and planned-for costs, and that can be operated within the expected cash flow available. HighRoad offers both of these.

a. Construction Costs – These are predictable since no new technology is involved, i.e., only standard concrete construction is used in the guideway and only standard electrical power systems are used to provide energy to the vehicle motors. The Bombardier system in Las Vegas and recently proposed (and rejected) in Seattle costs over $100 million a mile

b. Vehicle Costs – By using a body manufacturer already building similar bodies for another monorail company we are able to have team experience supporting our proposal. The costs, based on composite construction, are predictable. Sufficient competition is available within the industry to assure that a fair price for the bodies will be arranged.

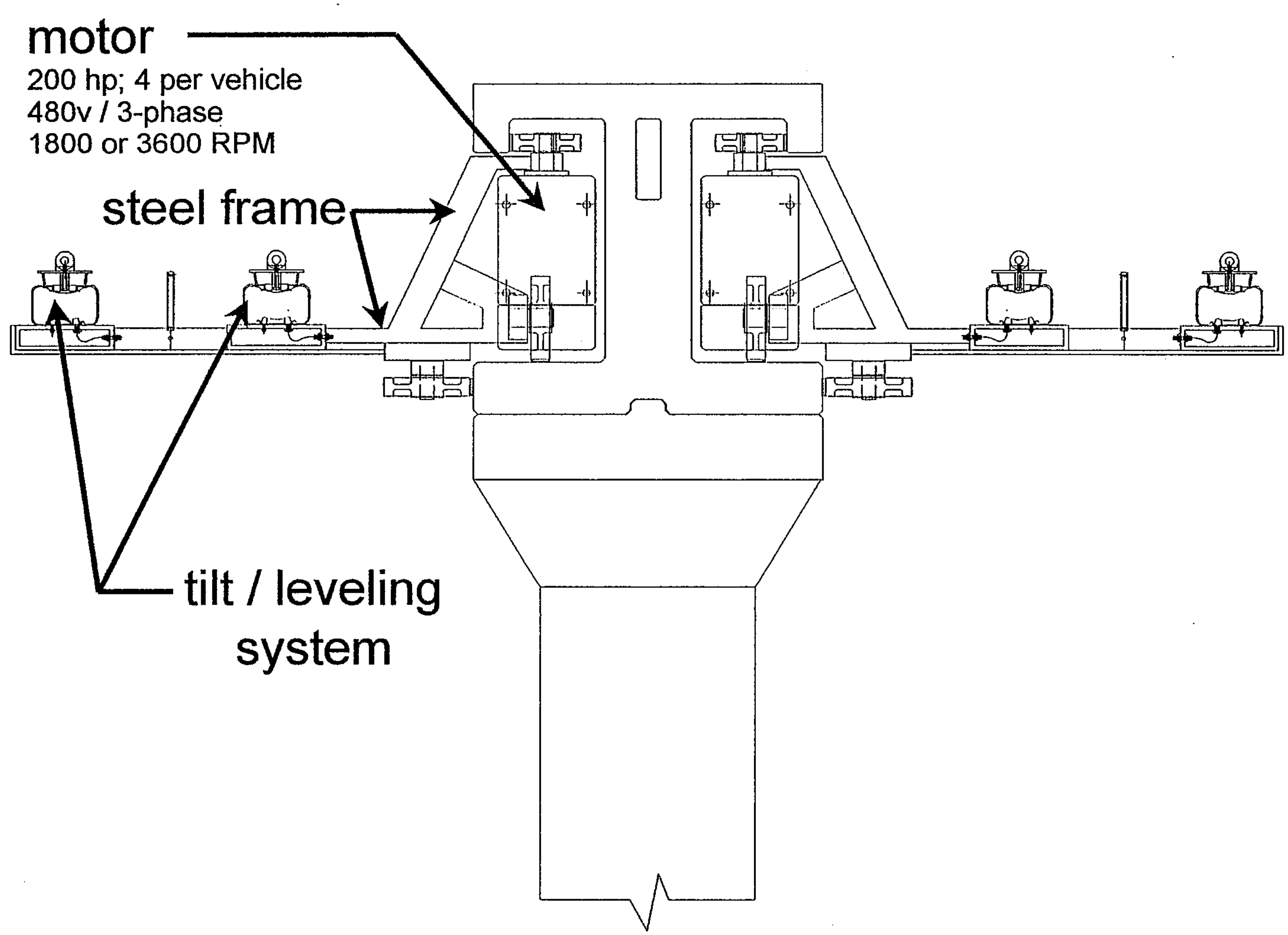
c. Controls Costs – Siemens Controls, used by thousands of large industrial companies around the world, has the components and software to apply their technology to assure a reliable and reasonably-priced system. Other companies also supply similar controls and software, assuring a competitive price is arranged for the HighRoad systems.

d. Operating Costs - The unique HighRoad system arrangement assures that minimum costs will be incurred in operation. With many vehicles providing two-direction service along a single narrow guideway the HighRoad provides the economical reuse of stations and vehicles at high frequencies. This is unlike heavy rail systems with very large stations and long trains using the stations infrequently. The HighRoad system therefore allows frequent reuse of the Capital involved, minimizing capital investment and reducing depreciation and operation costs associated with that investment. Also, the HighRoad system eliminates the conversion losses associated with Direct Current electrical power by using standard community-available 460/277V, 3-phase Alternating Current power.

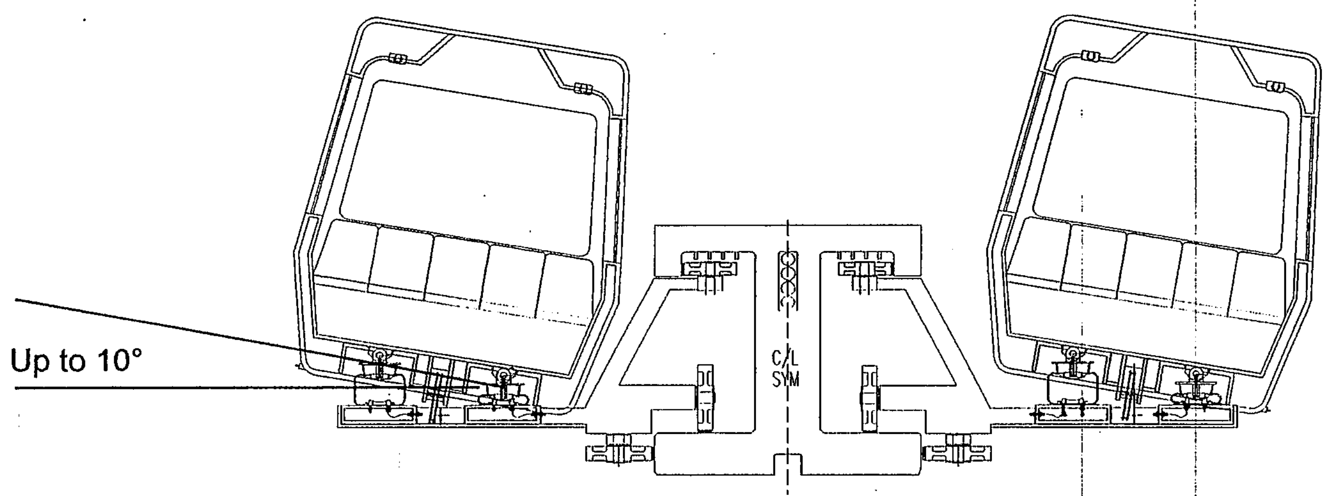
e. Results - By selecting HighRoad technology, with its advanced concepts and proven components, a transit agency can assure that the system operations will be outstanding in all respects, providing more frequent trip availability (shorter headways), lower fares, reduced subsidies, greater reliability, and an expanded reach into adjacent communities which are, at present, cost-prohibitive.

With selection of HighRoad technology, the transit agency can assure that its obligations to the community can be met, and that its management will continue to be highly-regarded as a result of its pro-community decisions.

HighRoad Technology



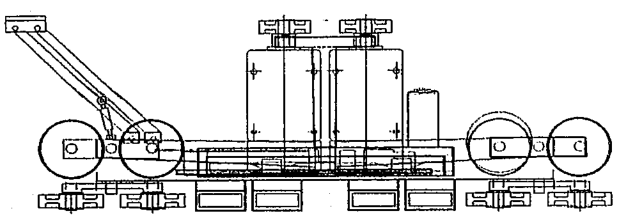
HighRoad Technology

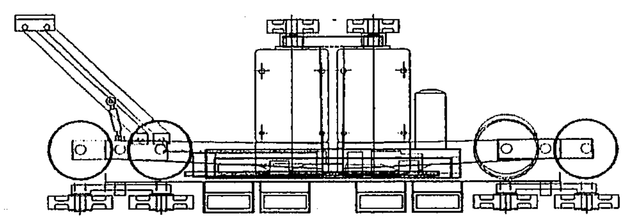


Airbags beneath each vehicle provide cabin tilting for passenger comfort and precise alignment in stations.

HighRoad Technology

System redundancy is key to reliable vehicle performance.

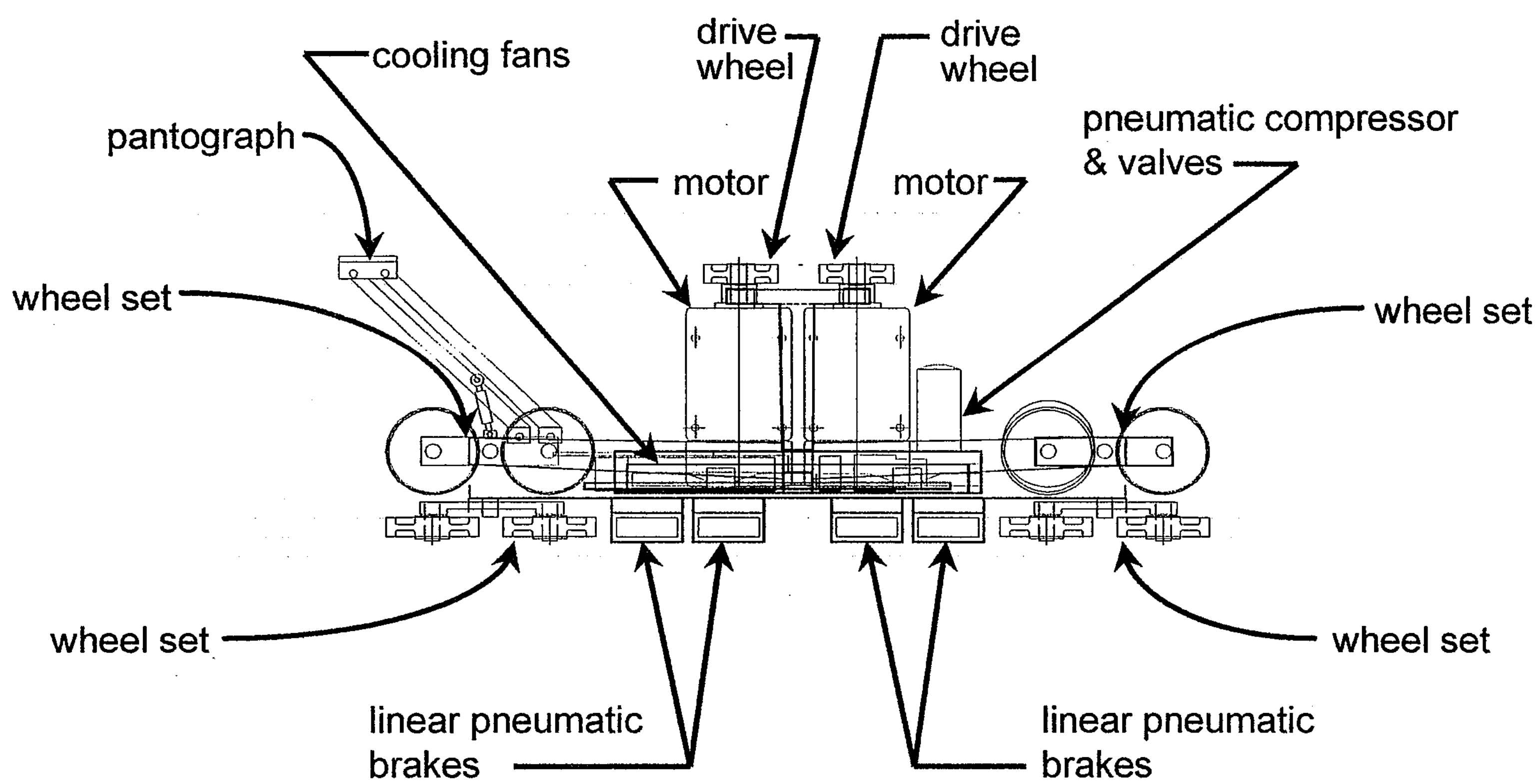




2 Drive bogies per vehicle provides:

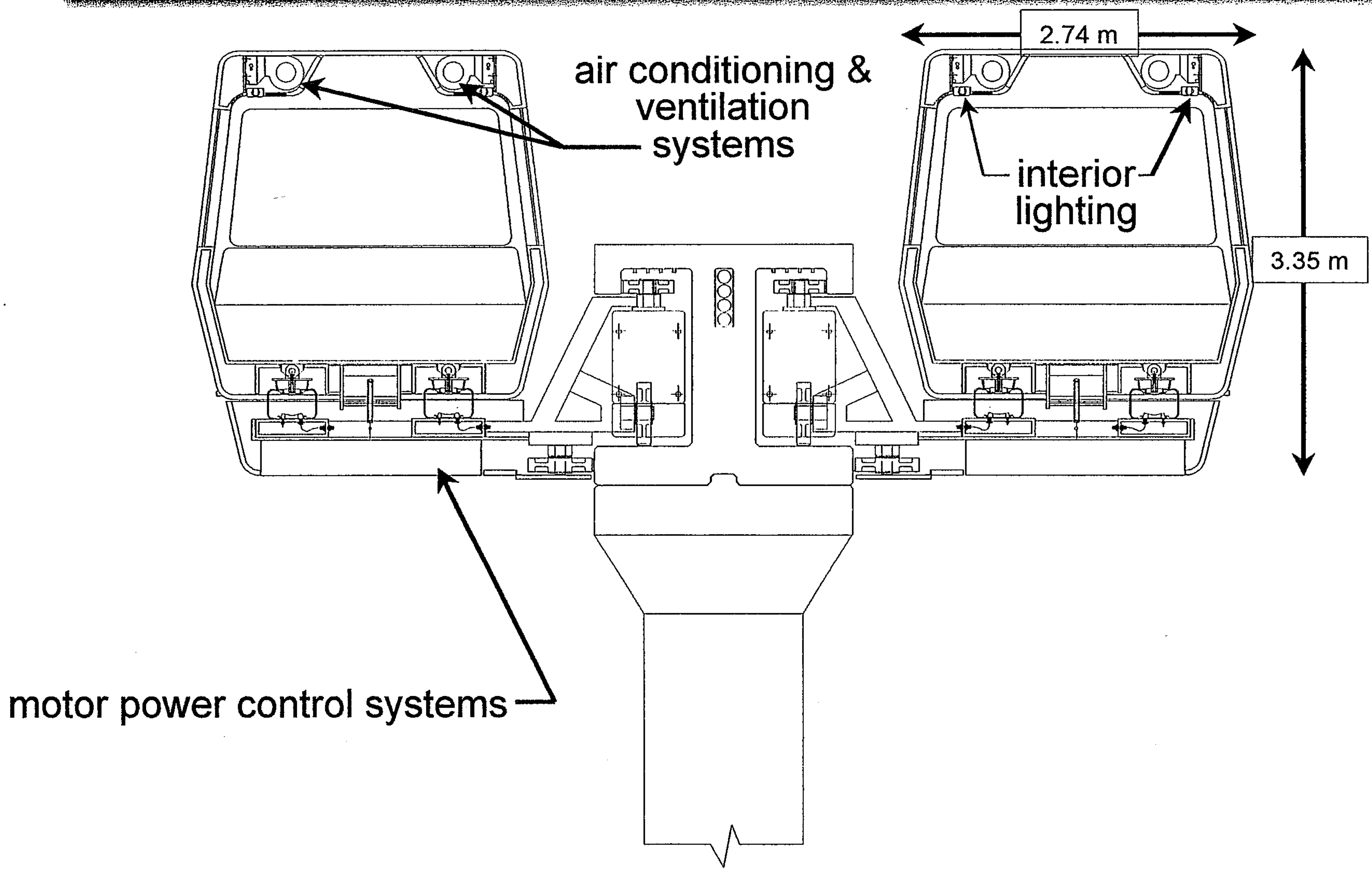
- 4 motors
- 4 regenerative brakes
- 8 backup brakes
- 2 power taps (pantographs)

HighRoad Technology



one of two drive bogies per vehicle

HighRoad Technology



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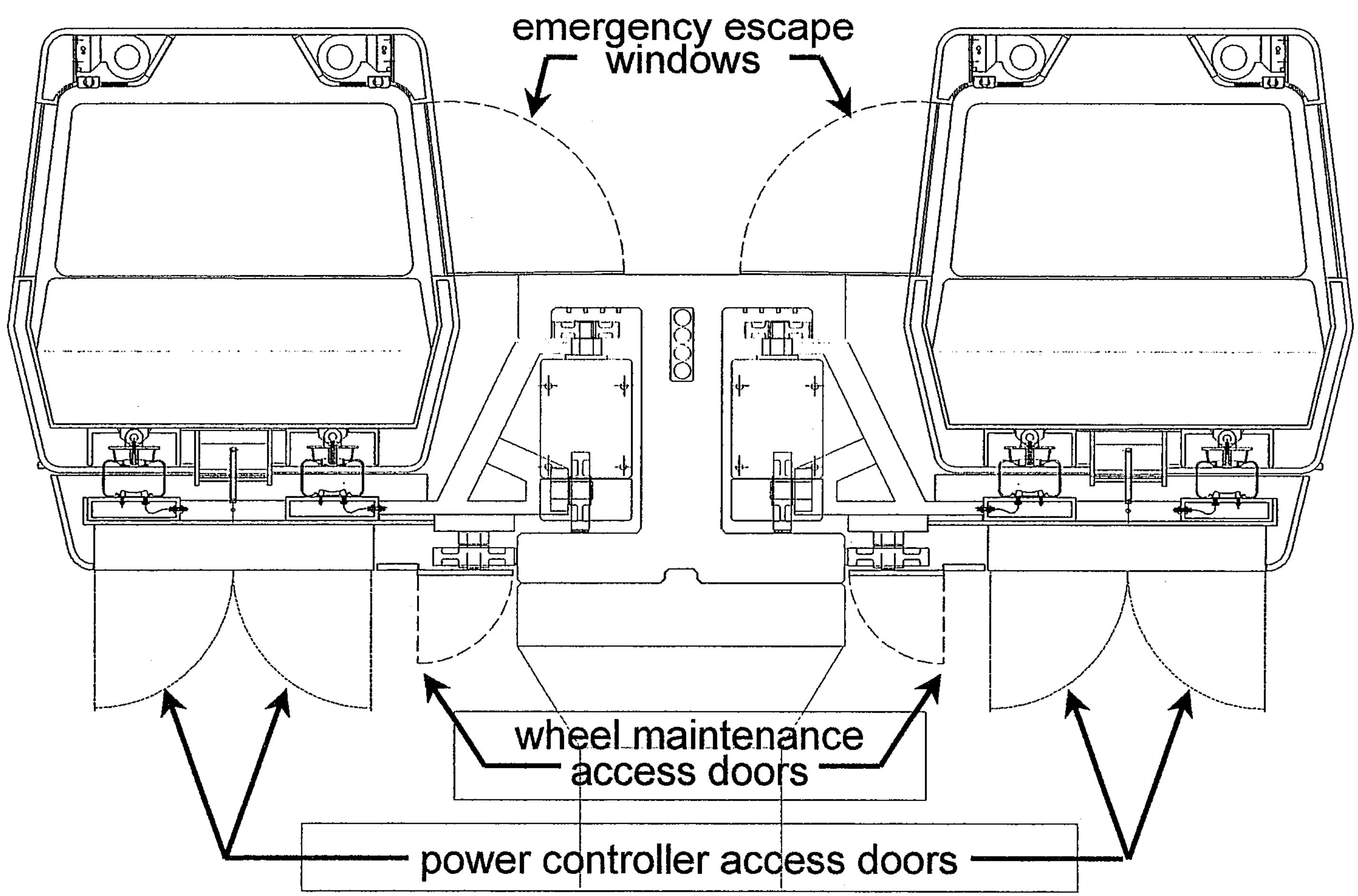
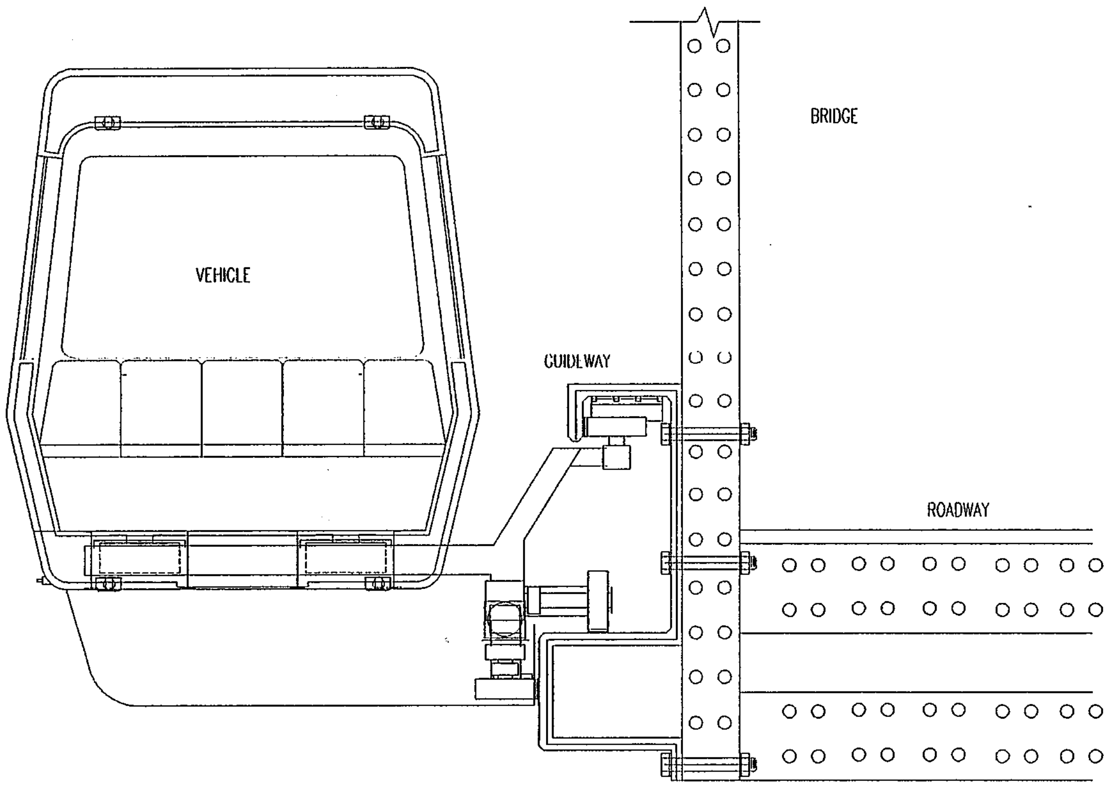
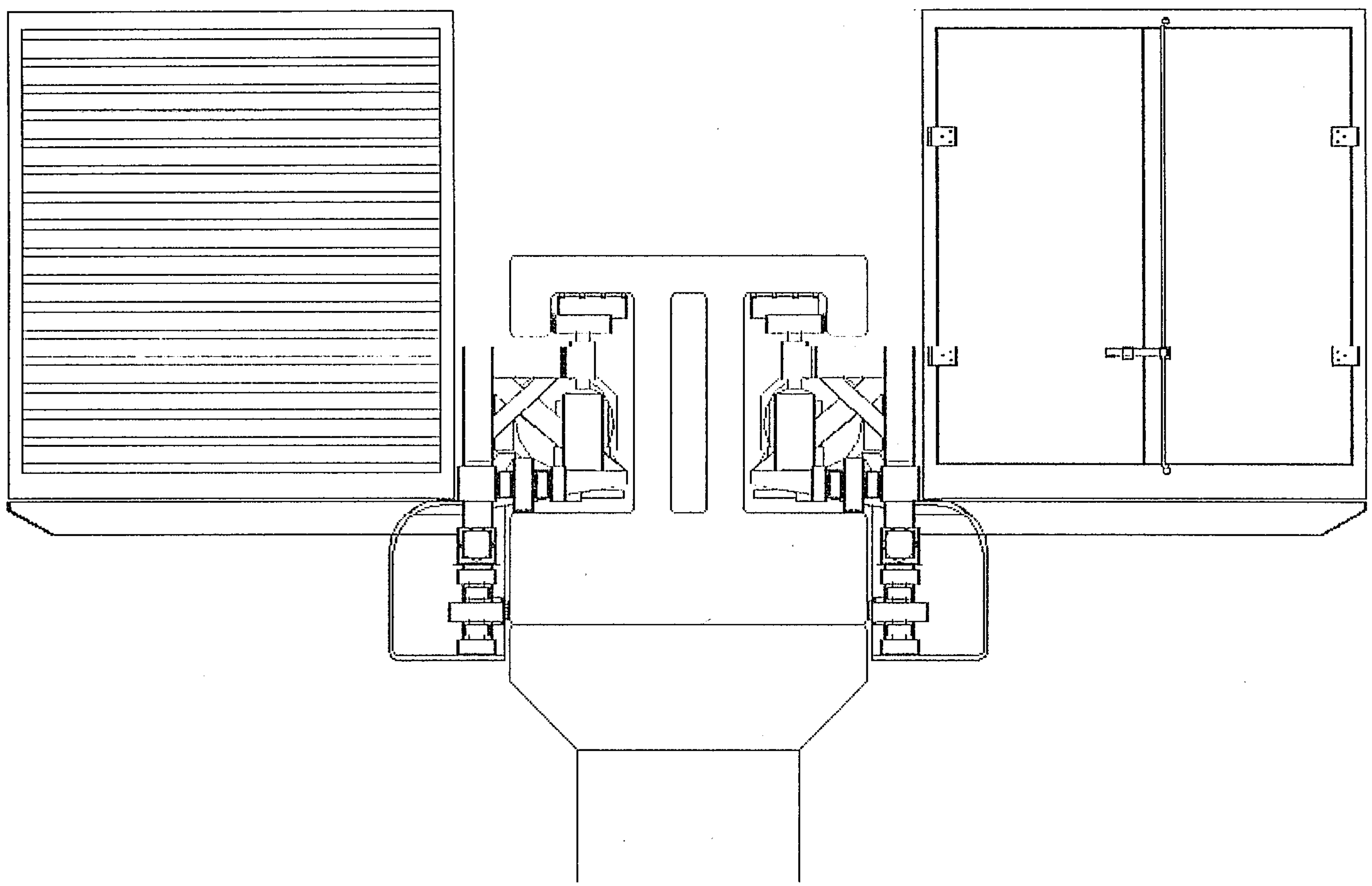


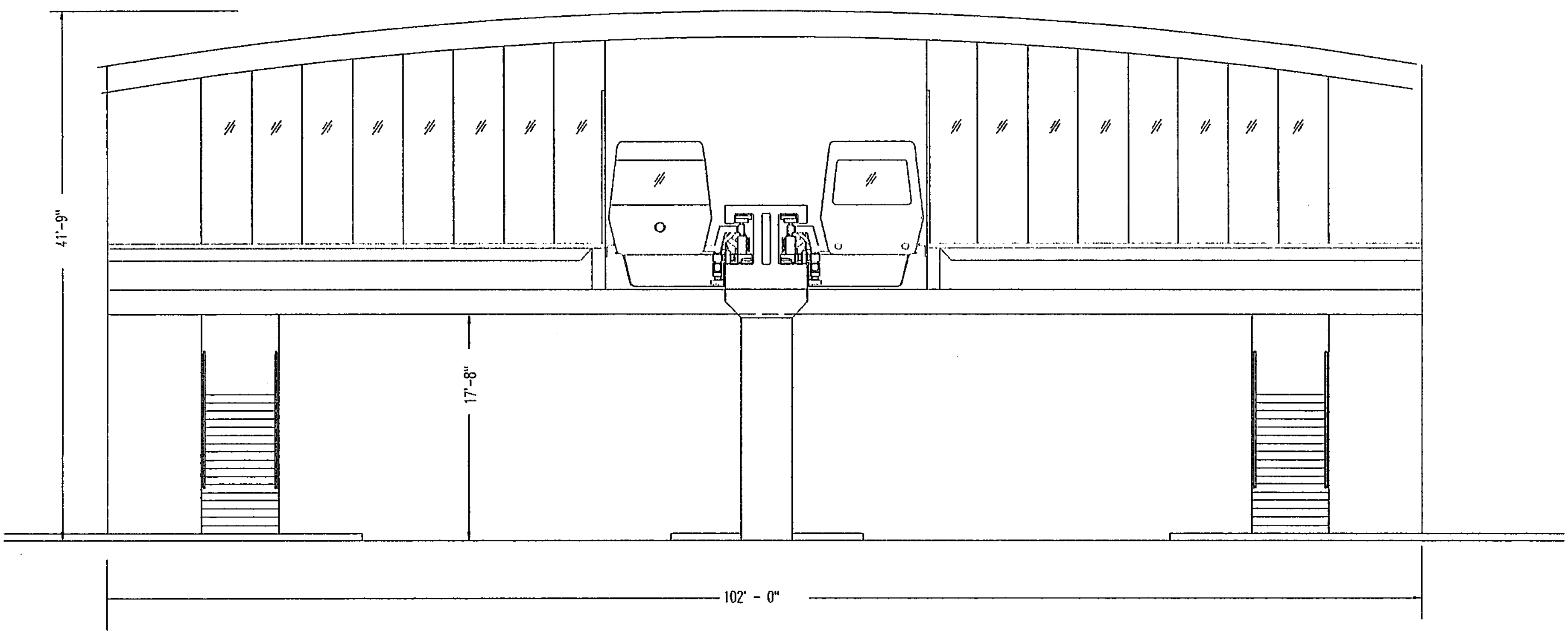
HighRoad Technology



HighRail Freight Transport Configuration

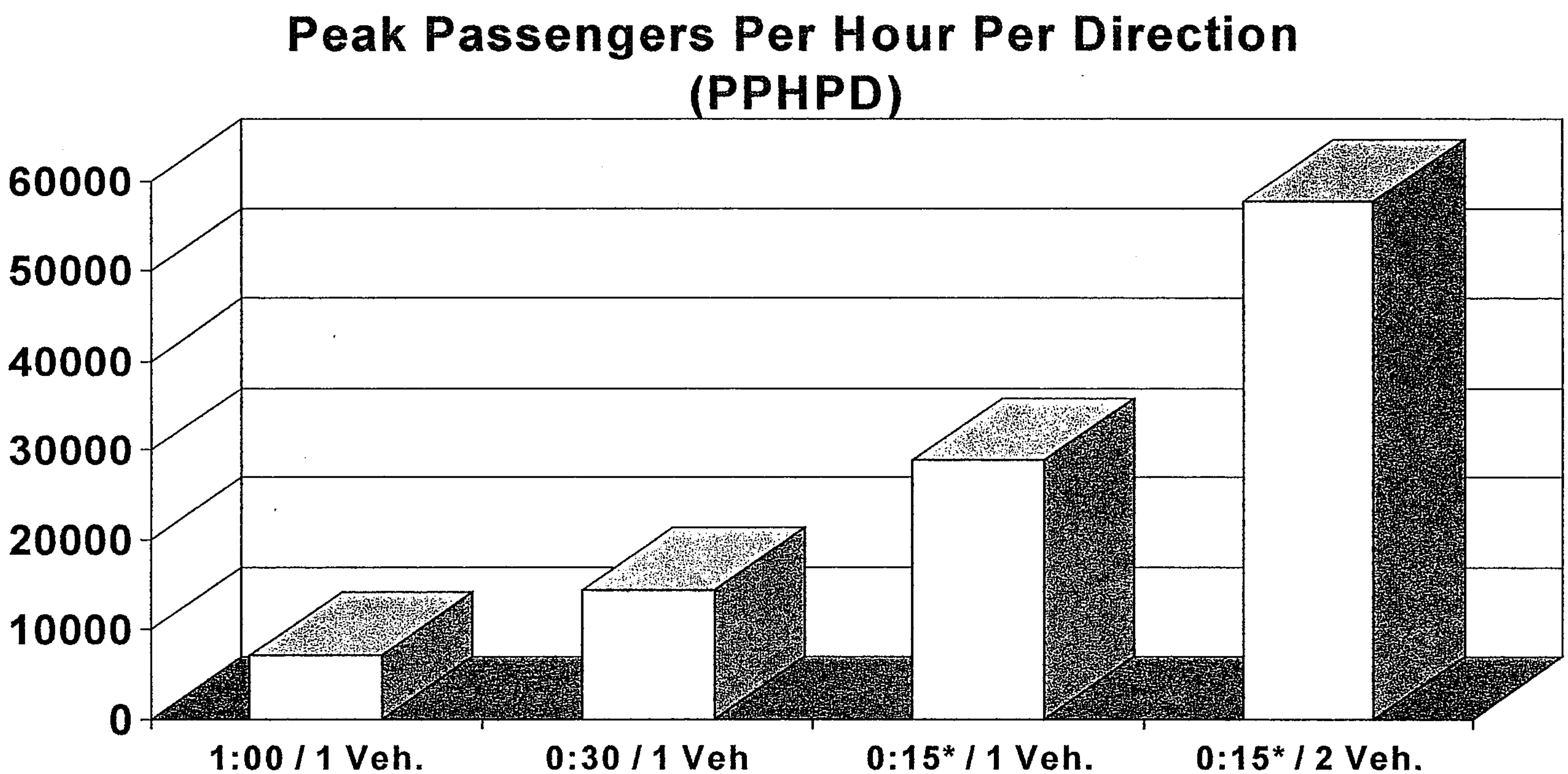


HighRoad Technology



STATION ELEVATION
SCALE: 1/8" = 1'-0"

HighRoad Passenger Capacity



* This capacity is based on the use of a 2-stage extended dwell of 0:45.